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**نموذج رقم (١٦)**
**اقرار والتزام بالمعايير الأخلاقية والأمانة العلمية وقوانين الجامعة الأردنية وأنظمتها وتعليماتها لطلبة الدكتوراة**

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عنوان الاطروحة: Diabetic Control and Its Associated Factors in Type 2 Diabetic Patients at the National Center for Diabetes, Endocrinology and Gentics In Amman, Jordan

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# Diabetic Control and Its Associated Factors in Type 2 Diabetic Patients at the National Center for Diabetes, Endocrinology and Genetics in Amman, Jordan


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## COMMITTEE DECISION

**This Thesis (Diabetes Mellitus Control and its Associated Factors in Patients with Type 2 Diabetes Mellitus at the National Center for Diabetes, Endocrinology & Genetics) was successfully Defended and Approved on 5/6/2011.**

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# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF APPENDICES

## List of Abbreviations

AACE: American Association of Clinical Endocrinologists

ADA: American Diabetes Association

BP: Blood pressure

CHD: Coronary heart disease

CKD: Chronic kidney disease

CVD: Cardiovascular disease

DCCT: Diabetes Control and Complications Trial

DM: Diabetes Mellitus

FPG: Fasting plasma glucose

IDF: International Diabetes Federation

IDDM: Insulin Dependent Diabetes Mellitus

HDL: High density lipoprotein

Glycosylated hemoglobin**:** Hemoglobin A1c (HbA1c)

IRAS: Insulin Resistance Atherosclerosis Study

LADA: Latent Autoimmune Diabetes in adults

LCPUFAs: Long-Chain Polyunsaturated Fatty Acids

LDL: Low density lipoprotein

NCDEG: National Center for Diabetes, Endocrinology and Genetics in Amman, Jordan

NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III

NGSP: National Glycohemoglobin Standardization Program

NHANES III: National Health and Nutrition Examination Survey

NIDDM: Non-Insulin Dependent Diabetes Mellitus

OGTT: Oral Glucose Tolerance Test

PAI-1: Plasminogen activator inhibitor-1

PPAR-γ: Peroxisome proliferator-activated receptor γ (PPAR-γ).

4-HDHA: 4-hydroxydocosahexaenoic acid

5-LOX:5-lipooxygenase

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## ABSTRACT

**Objective**: The purpose of this research is to assess the glycemic and metabolic control among type 2 diabetic patients attending the National Center of Diabetes, Endocrinology and Genetics in Amman, Jordan (NCDEG) and the change in glycemic and metabolic parameters during the treatment at the NCDEG.

**Methods**: Data were analyzed from a retrospective study that included a systematic random sample of 1576 patients' Medical files.

**Results**: Among the study population, the prevalence of Dyslipidemia was 96.3%. The prevalence of hypertension was 92.8%. The prevalence of the target glycemic control (HbA1c level <7%) among the study population was 38.3% in the last visit compared to 20.3% in the first visit. The prevalence of the target blood pressure (BP<130/80mmHg) among the study population was 27.3% in the last visit. The prevalence of the target total cholesterol (<200mg/dl), LDL cholesterol (<100mg/dl), HDL cholesterol (>50mg for women and>40 for men) and triglycerides (<150mg/dl) were 87.7%, 67.1%, 38.7%, and 54.3% respectively in the last visit.

**Conclusion**: The proportion of patients with optimal glycemic control, BP, total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides was nearly comparable to that reported from other countries. There was significant improvement in the HbA1c level, total cholesterol, LDL cholesterol and triglycerides after follow up. Factors associated with poor glycemic control were higher BMI, increased waist circumference and longer duration of diabetes mellitus (DM)

**Keywords**: Diabetes mellitus, Cardiovascular risk factors, Hypertension, Dyslipidemia, Jordan,.

# CHAPTER ONE
# INTRODUCTION

## Overview

Diabetes is a global health problem and has been described as the epidemic of the 21st century [1]. Approximately 194 million people worldwide have diabetes and this estimate is expected to increase to 333 million, or 6.3% of all the adult population by 2025 and 366 million by 2030 [2].

In the Arab region , the overall prevalence of diabetes mellitus in the Kingdom of Saudi Arabia is 23.7% in ages between 30-70 years [3].The prevalence of diabetes in the United Arab Emirates, Bahrain, Kuwait and Oman is 18.7%, 15.4%, 14.6% and 13.4% respectively [4]. In Jordan the study titled "An increase in prevalence of diabetes mellitus in Jordan over 10 years" by Ajlouni et al showed that the prevalence of diabetes and impaired fasting glucose (IFG) in Jordan was 17.1% and 7.8% respectively with no significant difference between females and males [5].

Diabetes mellitus is a group of metabolic derangements characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both[6].

Diabetes is diagnosed using a fasting plasma glucose level of 126 mg/dl or more after an eight-hour fast ,or by a two-hour oral glucose tolerance test with a glucose level of 200 mg/dl or more [7] .Diabetes is primarily categorized as type 1or type 2 [6].

People can live with diabetes without major complications as long as it is well controlled and managed. The aim of diabetes management is to adequately maintain normal blood glucose levels in order to prevent microvascular complications,e.g., retinopathy, neuropathy and nephropathy, and macrovascular complications,e.g.,peripheral vascular or cardiovascular disease [8] . A key element in diabetes management is glycemic control, which is indicated by the HbA1c level .The HbA1c test measures the percent of glucose in the bloodstream attached to certain constituents of the hemoglobin molecules in the previous two to three months, which is the lifespan of red blood cells. This test has been considered the gold standard for assessing glycemic control in diabetes care for the last 25 years [8, 9]. Although there are other methods of assessing glycemic control, the HbA1c test has been shown to be better than the serum fructosamine test because the latter only measures glycemic control in the last 2 weeks [10] .Although continuous (daily) blood glucose monitoring would provide the most accurate evaluation of a person’s average blood glucose levels, the HbA1c test is more practical, less costly, and more convenient than continuous blood glucose monitoring [11] .

Several guidelines for glycemic control currently exist. The American Diabetes Association (ADA) treatment goals for glycemic control recommend HbA1c values of <7.0% [12] .The International Diabetes Federation(IDF) and the American Association of Clinical Endocrinologists (AACE) recommend a HbA1c value of < 6.5%[13] . However, a HbA1c value of <7.0% is not always realistic for old individuals with several co-existing conditions , or those facing terminal illness[14] . Thus, two commonly used thresholds for glycemic control are a HbA1c value of ≥7%, which is generally considered suboptimal glycemic

control, and a HbA1c value of ≥9% which is an indicator of poor glycemic control [12, 15-17] .

Research has shown clear evidence of the benefits of good glycemic control in terms of diabetes-related complications. For example, it has been noted that a 1% decrease in the HbA1c value can lead to a 10% reduction in the risk of coronary artery disease [18, 19]. Moreover, good glycemic control has been associated with fewer diabetic complications and better metabolic control[9]. Studies have also shown that macrovascular and microvascular complications are related to poor glycemic control. For example, poor glycemic control has been associated with severe periodonitis [20], an increase in the incidence of proteinuria, symptoms consistent with diabetic neuropathy [21] ,and elevated C-reactive protein, a marker of systemic inflammation and risk factor for cardiovascular disease [22] .

Given the medical benefits of good glycemic control, strong efforts by health advocates and the medical community have been made to improve glycemic control among adults with diabetes. For example, national education programs targeted at the general public, such as the National Diabetic Education Program have launched campaigns like the "Control the ABC's" campaign, which stresses the importance of the HbA1c test, in addition to frequent blood pressure and cholesterol check-ups [23] . The Diabetes Quality Improvement Project is another diabetes program that has been developed in order to improve diabetes management [24] .This program's mission is to develop a set of standardized performance and outcome measures in order to make equal comparisons of diabetes management health care plans across the US [24] .

Despite research showing the importance of lower HbA1c levels for preventing diabetes complications and despite public health efforts towards diabetes management, glycemic control remains a serious public health problem in the world.

## Background and Significance of the Problem

There is evidence that diabetes and cardiovascular disease are related to lifestyle factors. According to Yusuf et al [25] the increase in urbanization has led to an increase in chronic diseases. As a rural population becomes more urbanized, the chronic disease prevalence goes up. This has been seen in the United States as well as in developing countries [26]. Although life expectancy has increased, lifestyle and diets have changed leading to a shift from infectious diseases to chronic diseases such as cardiovascular disease, diabetes, high blood pressure, and obesity.

Jordan, like other middle-income countries, is also witnessing an epidemiological transition, which is characterized by an increase in chronic diseases, particularly cardiovascular diseases, cancer, diabetes and chronic respiratory conditions. The major cardiovascular diseases are hypertension, coronary heart disease, and stroke [27] .These health problems are now becoming the leading causes of death in Jordan with cardiovascular diseases responsible for more than half of all deaths. According to the Jordan Morbidity Survey of 1996, about 40% of those aged 40 years and above are hypertensive [28] .Determinants and levels of risk factors for chronic diseases are rising. Smoking is a major problem, with more than 40% of adult men and 5% of women smoking regularly[27]. Obesity is another emerging problem which affects 60% of women

and 33% of men aged 25 years and above [29].The increase of obesity was attributed to excessive consumption of foods, wrong food choices, and low physical activity. Since cardiovascular disease is the main cause of morbidity and mortality in patients with diabetes, interventions to control cardiovascular risk factors like DM, hypertension, and dyslipidemia are essential to obtain good clinical results to reduce the excess of cardiovascular risk in diabetic patients.

## Purpose

The purposes of this study are:

1. Assess the glycemic and metabolic control among type 2 diabetic patients attending the NCDEG
2. Assess the change in glycemic control and metabolic parameters during the follow up at the NCDEG

# CHAPTER TWO

# REVIEW OF THE LITERATURE

## Diagnosis and Classification of Diabetes Mellitus

The diagnostic criteria for diabetes, as well as the classification of this disease have changed considerably since the 1980s. A diagnosis of diabetes, as defined by the American Diabetes Association (ADA), requires one of the following four criteria to be met: fasting plasma glucose (FPG) ≥ 126 mg/dL (7.0 mmol/L) after a minimum of eight hours with no caloric intake, symptoms of hyperglycemia and a casual (random) plasma glucose ≥ 200 mg/dL (11.1 mmol/L), two-hour plasma glucose ≥ 200 mg/dL (11.1 mmol/L) during a 75-gram oral glucose tolerance test (OGTT), or glycated hemoglobin A1c (HbA1c) ≥ 6.5% using a method that is National Glycohemoglobin Standardization Program (NGSP) certified and standardized to the Diabetes Control and Complications Trial (DCCT) assay [(30)].The ADA also notes that if results are abnormal, a repeat test on the subsequent day should be performed to confirm the diagnosis [(30)].

The FPG has been the preferred test for diagnosis due to convenience and reliability when measured in the true fasting state. For the same reason, this test is commonly used in epidemiological studies to characterize study populations and identify undiagnosed diabetes cases [(6,31)]. The OGTT uses a standardized glucose load containing the equivalent of 75 g of anhydrous glucose that is dissolved in water and a patient's plasma glucose is measured two hours following consumption. The HbA1c cut off point of ≥6.5 % is a recent addition to the diagnostic criteria [(30)].

The type of diabetes assigned at diagnosis often depends upon symptoms at presentation to the clinic [30].Complicating this issue is the fact that many diabetes cases do not easily fall into a single class [30]. For example, a woman with a gestational diabetes might remain hyperglycemic after delivery and be later diagnosed with type 2 diabetes. Despite the assigned type, all diabetes cases share the common characteristic of blood glucose levels that are abnormally high.

The current approach to classifying diabetes is based on the etiology of this disease rather than on its treatment and includes four categories: (i) type 1 diabetes, (ii) type 2 diabetes, (iii) gestational diabetes, and (iv) other specific types of diabetes [32,33,34].

Type 1 diabetes, formerly known as "insulin dependent diabetes mellitus (IDDM) or juvenile onset diabetes, is characterized by pancreatic beta cell destruction (either autoimmune or idiopathic) and the subsequent inability to produce insulin [32]. Type 1 diabetes is typically diagnosed in childhood or adolescence. 'Latent Autoimmune Diabetes in Adults' (LADA) is a latent form of type 1 diabetes that is present in approximately 6 to 10% of adults over the age of 25 years with diabetes [32,35]. Although LADA can initially be misdiagnosed as type 2 diabetes given its presentation in adults, individuals affected by this form of diabetes are typically younger than those with frank type 2 diabetes [35].

Type 2 diabetes, previously classified as 'non-insulin dependent diabetes' (NIDDM) or adult-onset diabetes, is characterized by insulin resistance (i.e., diminished tissue response to the actions of endogenous insulin) and abnormal

insulin secretion from the pancreas (i.e., beta cell failure), either of which may predominate in a given individual (36,37). This type of diabetes usually occurs after age 30 and depending on the population studied, the mean age at diagnosis is often well into the sixth decade (32,34,38,39). Consequently, one of the characteristics that generally distinguishes type 2 from type 1 disease is the age at diagnosis. Although type 2 diabetes is increasingly being diagnosed in obese children and adolescents, subjects at an older age at treatment initiation are more likely to represent type 2 diabetes. Type 2 diabetes is the predominant clinical manifestation of this disease and accounts for more than 90% of all cases (37,40).

Gestational diabetes mellitus is characterized by the onset or recognition of glucose intolerance during pregnancy.

Other specific types include diabetes secondary to genetic defects of β-cell functions or in insulin action, endocrine disorders, drug or chemical induced infections, uncommon forms of immune-mediated diabetes and other genetic syndromes sometimes associated with diabetes (32,34).

## Complications of Diabetes

The complications associated with diabetes are primarily microvascular and macrovascular diseases that result from accelerated atherogenesis (41). Type 2 diabetes patients die of macrovascular CVD at rates that are two to four times higher than subjects of similar demographic characteristics without diabetes (42-45). With such a large proportion of patients developing cardiovascular complications, close CVD risk factor management is crucial in patients with diabetes.

## Microvascular Complications

Microvascular complications of diabetes include retinopathy, nephropathy, and peripheral or autonomic neuropathy. The structure and function of the eye tend to be severely affected by diabetes [46] .The primary microvascular complication is diabetic retinopathy, which is the leading cause of blindness in adults aged 20-64 years in the United States, with nearly one million of those having sight-threatening retinopathy [47]. Also of interest is that new studies in large populations show retinal vascular changes even in pre-diabetes cases prior to overt diabetes [48].

The pathogenic event common to retinopathy is the abnormal vascular development of excessive and leaky blood vessels in the retina, leading to visual impairment [49]. A study by Sapieha et al[50]showed the beneficial effects of n–3 long-chain polyunsaturated fatty acids (LCPUFAs) on a mouse model retinopathy because LCPUFAs inhibit pathologic neovascularization through the 5-lipooxygenase (5-LOX) pathway, which is the main enzymatic route through which n–3 LCPUFAs inhibit pathologic neovascularization through the production of 4-hydroxydocosahexaenoic acid (4-HDHA) and through peroxisome proliferator-activated receptor γ (PPAR-γ) [50].

**Macrovascular Complications**

Longitudinal data from the Framingham Study found that the risk factor-adjusted relative risk of coronary heart disease (CHD) was 1.38 (95% CI:0.99-1.92) times higher and the risk for CHD death was 1.86 times greater (95% CI: 1.17-2.93) for each 10-year increase in duration of diabetes [(51)]. Diabetes also increases risk of stroke with a relative risk ranging from 1.8 to close to 6.0 compared to non-diabetic subjects [(52)]. Insulin resistance is believed to be the primary cause of atherosclerotic damage in diabetics; hyperinsulinemia leads to increased atherogenesis both directly and indirectly through the effects of insulin on blood lipids and blood pressure [(53)].

## Cardiovascular Disease and Diabetes

Di'Agostino et al [(55)] studied 872 subjects with normal or impaired glucose tolerances that were included in the Insulin Resistance Atherosclerosis Study (IRAS). The significant risk factors that were reported to be predictive of type 2 diabetes were: high plasminogen activator inhibitor-1(PAI-1), hypertension, high triglycerides, low HDL-cholesterol, and Impaired Glucose Tolerance (IGT). Odds ratio (OR) was calculated. The OR increases the risk of acquiring type 2 diabetes by 2.1 for every additional risk factor from 0 to 5. Thus, multiple risk factors substantially increase the risk of diabetes.

According to Donahoe et al [(56)] people with diabetes have a greater risk of mortality following a cardiovascular event than those without diabetes. Their study included 62,036 patients. These patients with acute coronary syndromes were from 11 independent clinical trials from 1997-2006. Mortality was assessed at 30 days and at one year. Those with diabetes were more likely to

have multi-vessel coronary disease (62.0% compared to 48.1%). Mortality was significantly greater at 30 days and at 1 year (P<0.001). In the 16-year follow-up to the Framingham Heart Study, 239 patients with diabetes were found to have a 3-fold increase in age-adjusted cardiovascular mortality [57]. Subjects without diabetes with a myocardial infarction (MI) have a similar risk of death from CVD as someone with type 2 diabetes without a prior MI [44]. According to the National Cholesterol Education Program Expert Panel (2002), diabetes has the risk equivalent of CVD for a future MI or CVD mortality.

In another multicenter study done in Tunis (375 women and 333 men), it was confirmed that type 2 diabetic patients have many associated cardiovascular risk factors. The prevalence of cardiovascular risk factors in these patients were as follows: obesity (32.8%), smoking (68.5%), hypertension (59.1%), hyper-triglyceridesmia (31.9%) and hypercholesterolemia (26.8%) [58].

In Jordan, in a study that was conducted to investigate the prevalence of DM, IGT and their risk factors, it was found that the factors independently associated with DM were sex, age, hypertension, hypercholesterolemia and hyper-triglyceridemia [3].

## Standards of Care

Standards of care are intended to provide clinicians, patients and researchers with the components of diabetes care, treatment goals, and tools to evaluate the quality of care. A variety of professional organizations have developed standards of care and associated clinical practice guidelines. These guidelines share common elements, but vary slightly in frequency of evaluation and/or clinical laboratory levels. Standards and guidelines associated with one internationally

recognized organization–the American Diabetes Association, are the reference for many health care providers [59]. ADA has been actively involved in the development and dissemination of diabetes care standards, guidelines, and related documents for many years. These statements published in the Association's website and professional journals are a convenient and important resource for all health care professionals who care for people with diabetes. While individual preferences, co-morbidities, and other patient factors may require modifications of goals, targets that are desirable for most patients with diabetes are provided. Current recommendations for the care of patients with diabetes are [59, 60]:

1. Develop or adjust the management plan to achieve normal glycemia with an HbA1c goal of <7%.

2. Perform the HbA1c test at least two times a year in patients who are meeting goals and four times a year in patients who are not.

3. Self-blood glucose monitoring is an integral part of diabetes therapy and is included in the plan of management

4. People with diabetes should receive dietary counseling.

5. A regular physical activity program is recommended for all persons with diabetes who can function (at least 150 minutes per week of moderate-intensity aerobic physical activity).

6. Blood pressure should be measured at each visit and should be less than 130 mmHg systolic and 80 mmHg diastolic.

7. Test for lipid values should be at least annually with low-density lipoprotein (LDL) cholesterol less than 100, high-density lipoprotein (HDL) cholesterol greater than 50 for women and 40 for men, and triglycerides less than 150.

8. Use of aspirin 75 to 163 milligrams a day for all patients over 40, unless contraindicated.

9. Include smoking cessation counseling, if needed.

10. Perform annual test for microalbumin.

11. Receive a comprehensive foot examination annually.

12. Receive a comprehensive eye examination annually.

13. Receive pneumococcal vaccinations and annual influenza injections.

## Assessing and Maintaining Glycemic Control

The American College of Endocrinology convened a consensus development conference on glycemic control in 2001, and developed a consensus committee statement that represents the panel's collective analysis, evaluations and opinions based on the literature and conference proceedings. The consensus panel believed that the setting of clinical standards related to glycemic control should reflect the best estimate of maximal benefit that may accrue from that care and should not depend on the case or convenience of attaining such targets for patients or clinicians. Additionally, the panel believes that establishing glycemic targets that assist and encourage patients and clinicians to achieve normoglycemia will result in improved health, augmented longevity, and enhanced quality of life, which are all the goals of diabetes management [61].

Maintenance of glycemic control requires an ongoing assessment of nutritional intake, activity, concomitant medications such as steroids and blood glucose. This type of monitoring is essential in assessing the efficacy of insulin therapy and oral medications and determining the need for adjustments to the prescribed treatment regimen [(62)]. Factors such as age, income, years of education, occupation and literacy, as well as failure to keep appointments, poor adherence to prescribed hypoglycemic medications and the lack of understanding of diabetes as well as the importance of good glycemic control can limit the effectiveness of management [(63)].

Provider-related factors may be even more important, since providers often fail to intensify diabetes therapy appropriately when patient glycemic control is poor[(64)]. This slows the process of achieving therapeutic targets and could compromise the ability of health care systems to reduce the morbidity, mortality and associated costs with diabetes [(63)] .Maintaining blood glucose levels at <200 mg/dL has been shown to benefit a variety of hospitalized patients [(65)] .

Glycemic control should be assessed primarily by periodic measurement of Hemoglobin A1c levels and secondary assessments should include the regular measurement of both the fasting preprandial and postprandial glucose levels. The "gold standard" for assessing and monitoring glycemic control in patients with type 1 and type 2 diabetes has become the Hemoglobin A1c. The upper limit of normal for the Hemoglobin A1c is generally 6.0 % [( 61)]. In the blood, glucose binds irreversibly to hemoglobin molecules within red blood cells. The amount of glucose that is bound to hemoglobin is directly tied to the concentration of glucose in the blood. Since red blood cells have a lifespan of approximately 90 days, measuring the amount of glucose bound to hemoglobin

can provide an assessment of average blood sugar control during the 60 to 90 days prior to the test. This is the purpose of the glycated hemoglobin tests, most commonly the Hemoglobin A1c measurement [61].

Findings from the Diabetes Control and Complications Trial (DCCT)[66] showed that the strict control of blood glucose through intensive therapy in patients with type 1 diabetes may reduce the development and progression of long term complications. Additionally, similar benefits of tight glycemic control also appear to occur in patients with type 2 diabetes from the U.K. Prospective Diabetes Study Group (UKPDS).Findings also from this study suggest that intensive life-long treatment strategies may be cost effective [36].

A retrospective database analysis performed by Gilmer et al[67] which was based on administrative and laboratory data from a managed care plan, indicated that poorer glycemic control, as measured by the Hemoglobin A1c levels, was associated with greater health care cost over a 3-year time period, particularly for patients with hypertension and/or heart disease. Some costs, such as those for kidney disease, heart disease and those for lower extremity amputation may not be affected by Hemoglobin A1c levels evaluated over short time intervals since it often takes many years for complications such as these to develop [68].

## Assessing Modifiable Cardiovascular Risk Factors in Diabetes

It is well known that type 2 diabetes is frequently associated with cardiovascular risk factors such as hypertension and dyslipidemia and that the prevalence of other factors, such as smoking, sedentary lifestyle, and obesity is greater than in the non-diabetic population. The recognition and control of these factors, lifestyle modifications together with strict blood sugar control, is essential in

order to reduce the high cardiovascular morbidity and mortality in these patients. Several well designed randomized clinical trials have demonstrated how intervention to reduce the major, modifiable risk factors has a beneficial effect on cardiovascular morbidity and mortality in diabetic patients [69,70]. Also, an intensified, sustained, multifactorial intervention study in type 2 diabetic patients with multiple risk factors and microalbuminuria reported a 50% reduction in macrovascular and microvascular events[71].

The current approach to type 2 diabetes involves an intensive, multifactorial intervention aimed at reducing the overall risk of cardiovascular disease, and delaying the appearance of micro and macrovascular complications. As set out in clinical practice guidelines, this intervention includes lifestyle modification, strict control of blood sugar and of the other non-controlled modifiable risk factors, such as hypertension and dyslipidemia.

In a multicenter cross-sectional study in Spain that evaluated the level and factors affecting control of diabetes and cardiovascular risk factors in type 2 diabetes patients, results from the study showed that among the 1,907 patients (51% women), smoking prevalence was 22.6%, while 50.6% had levels of HbA1c>7%. Only 7.8% have achieved the target of BP < 130/80 mmHg. Among the 1,180 patients (65%) treated for hypertension, the target was attained in only 4.4% of the patients. A measurement for low-density lipoprotein (LDL) cholesterol was available in 1,669 patients (88%) with only 5.9% achieving the target of LDL cholesterol. As for the treatment for dyslipidemia, this target was attained in only 56% of the patients [72].

Del Canizo-Gomez & Moreira-Andres[73]studied 501 patients in a cross-sectional study that assessed the degree of control of modifiable cardiovascular risk factors in type 2 diabetic patients using the following parameters: HbA1c < 7.0%, FPG < 7.2 mmol/L, postprandial capillary glucose<10.0 mmol/L, HDL-C > 1.1 mmol/L, LDL-C < 2.6 mmol/L, triglycerides levels < 1.7 mmol/L, systolic blood pressure < 130 mmHg, diastolic blood pressure < 80 mmHg, BMI < 25 $kg/m^2$ , waist circumference < 88 cm in women and < 102 in men and current non-smoking status. The results showed that 96 patients (19%) had coronary artery disease, 207 patients (41%) had an HbA1c < 7.0 %, 134 (27%) had FPG < 7.2 mmol/L and 231 of the 353 subjects (65 %) had postprandial capillary glucose < 10.0 mmol/L, and only 206 (41%) achieved an LDL-C of <2.6 mmol/L. Other parameters also showed low results. The researchers concluded that none of the patients had optimal control of all their cardiovascular risk factors.

In another cross-sectional multicenter epidemiological study that was conducted in a primary care setting in Catalonia, Mengual et al[74] studied the degree of control of HbA1c combined with the cardiovascular risk factors in type 2 diabetic patients using the GedapS 2004 guidelines and analyzed the type and intensity of drug treatment. Results showed that in the 392 patients, duration of diabetes was 8.4 years (SD=7.6), and the degree of mutlifactorial control of risk factors was only 2.6%. More than 50% of the individual cardiovascular risk factor was controlled, except for LDL cholesterol which was 40.6% and systolic blood pressure was 29.6%. Furthermore, only 13% of the subjects had an optimal BMI (27.5% optimal waist circumference). Treatment for diabetes was

prescribed in 82.7% of patients, for hypertension in 70.7%, and for dyslipidemia in 47.2% while40.1% were taking antiplatelets.

Colivicchi et al[75] assessed the extent to which hyperglycemia, hypertension and dyslipidemia are detected, treated and controlled in diabetic patients attending a network of urban community-based diabetic care clinics in Italy. The study included a population of 1,078 patients with type 2 diabetes mellitus (47% women, mean age 67.6+/-9.8 years) who visited eight diabetic care clinics. The values of glycosylated hemoglobin, blood pressure and cholesterol sub fractions as well as clinical and medication data were collected in all cases in a computerized database. Only 29.6% of patients met the treatment goal of a systolic blood pressure <130 mmHg despite a high prevalence of hypertension (66.6%), while a diastolic blood pressure <80mmHg was reached by 38.6% of the cohort study. Eventually, 25.5% of the cases have optimal LDL cholesterol values ( <100 mg/dL) while HbA1c of < 7% was achieved in 57.8% patients.

Velasco et al[76] in a cross-sectional multicenter study in Spain tried to assess the degree of glycemic control and its associated factors in 679 patients with diabetes mellitus. Factors associated with glycemic control were analyzed by means of multiple logistic regression analysis. A total of 53.1% (CI:49.3-56.9) showed good glycemic control (distribution among groups: 31.5%, 32% and 65.4%, respectively; p< 0.001). Predictive factors for unsatisfactory control were age (odds ratio [OR] = 0.984), time from diagnosis (OR=1.033) and insulin treatment (OR=4.054) (p< 0.001). The study showed that only 3% of the individuals achieved all the objectives recommended by the American Diabetes Association.

However, in a study using the data[77] from NHANES 1999-2000, 37.0% of participants achieved the target goal of a HbA1c level less than 7.0% and 37.2% of the participants were above the recommended HbA1c level of greater than 8.0%; these percentages did not change significantly from the NHANES III. Furthermore, only 35.8% of the participants achieved the target of systolic blood pressure less than 130 mmHg and diastolic blood pressure less than 80 mmHg, while 40.4% had hypertensive blood pressure levels (SBP 140 or DBP 90 mmHg). These percentages did not change significantly from the NHANES III ($p=.10$ and $p=.56$, respectively). The results found that over half (51.8%) of the participants in the NHANES 1999-2000 survey had a total cholesterol level of 200 mg/dL or greater (versus 66.1% in NHANES III; $p<.001$). In total, only 7.3% (95% confidence interval, 2.8%-11.9%) of adults with diabetes in NHANES 1999-2000 attained the recommended goals of a HbA1c level < 7%, blood pressure < 130/80 mmHg, and total cholesterol < 200 mg/dL (5.18 mmol/L).

Meisinger et al[78] in their study reported relatively few people with type 2 diabetes who achieved treatment targets of Hb1Ac < 7% (46.6%) , total cholesterol <200mg/dL (44.1%) and LDL cholesterol < 100 mg/dL (16.0%). Optimal HDL cholesterol values (> 45 mg/dl in men, > 55 mg/dl in women) were found in 55.8%, and blood pressure values < 130 and <85 mmHg in 31.3% of the people while microalbuminuria was revealed in 27.2% and macro-albuminuria in 9.0% of the 581 included diabetic people.

Cortez-Diaz[79] in a study which included 16,856 individuals (mean age 58.1 +/- 15.1 years; 61.6% women) of whom 3,215 were identified as diabetic reported the prevalence of DM adjusted for gender and age in primary health

care users to be 14.9%, higher in men (M: 16.8%; F: 13.2%) and increased with age. Among the diabetic population, 90.2% were being treated with antidiabetic drugs and 51.7% had HbA1c lower than 7%. Around 91% had high BP (≥130/80 mmHg or were taking antihypertensive medication), 39.5% were overweight, 45.1% were obese, 69.3% had abdominal obesity, 71.8% had metabolic syndrome (ATP III criteria), 12% presented with CAD and 5% had past history of stroke. The association between these cardiovascular (CV) risk factors and DM was stronger in women, and the impact of DM on occurrence of CAD and stroke was also higher in women. Among hypertensive diabetics, 78.4% were being treated with antihypertensive drugs, but only 9.3% had BP < 130/80 mmHg (M: 9.5%; F: 9.1%). Results showed that 94.2% of diabetic patients with CAD were taking antihypertensive medication, but only 9.8% had controlled BP (M: 13.7%; F: 6.1%). Although 59% of the diabetic population was being treated with statins, only 6.7% had total cholesterol < 200 mg/dl, triglycerides < 150 mg/dl and HDL-cholesterol > 60 mg/dl. Of diabetic patients with CAD, 76.5% were being treated with statins, but only 29.4% had total cholesterol < 175 mg/dl (M: 34.2%; F: 24.1%).

Bergenstal et al [80] questioned the current approaches used by physicians to address macrovascular risk factors among patients with diabetes and their effect on glycosylated hemoglobin (HbA1c), blood pressure, and low-density lipoprotein cholesterol (LDL-C) goal accomplishment. After evaluating the metabolic profiles of patients, it was obvious that physicians assigned the highest treatment priority to glucose control for 67.6% of patients. The treatment rates during the 12-month follow-up were highest for glycemic control (87.2%), followed by blood pressure management (77.9%), and lipid control (63.9%). The

study also showed that among treated patients, goal attainment for HbA1c, LDL-C, and blood pressure was 57.6%, 47.7%, and 22.8%, respectively. Regardless of treatment strategy, follow-up goal attainment was the highest for HbA1c (54.8% to 72.3%), followed by LDL-C (41.7% to 48.4%), and lowest for blood pressure (12.0% to 37.1%).

Beaton et al[81] conducted a retrospective study to evaluate the adequacy of the glycemic, lipid, and blood pressure (BP) management for diabetic patients in a managed care organization (MCO). Retrospectively, they studied 7,114 subjects aged ≥18 years old with diabetes identified over a 2-year period from the MCO's administrative database based on the Health Plan Employer Data and Information Set 2000 selection criteria using pharmacy, laboratory, and encounter data. Analysis and examination of demographics and percentages of patients were tested against the American Diabetes Association goals for HbA1c, lipids, and BP for those receiving medication treatment versus no treatment. The results of the testing rate for HbA1c, LDL cholesterol, and BP were 77%, 54%, and 95%, respectively. The percentage of patients tested who were at goal was 37% for HbA1c, 23% for LDL cholesterol, and 41% for systolic BP. Of the sample patients 72% were treated for glycemic control, 64% were treated for BP control, and only 28% were treated for lipid control. Of the patients who received medication treatment, less than one-third were at goal for HbA1c (29%) and LDL cholesterol (32%), whereas 40% were at goal for systolic BP.

In another study conducted by Suzuki et al[82] that investigated the prevalence of achieving recommended goals for glycemic and blood pressure control in Type 2 diabetic patients (study included 3,573 patients aged 63.5 +/- 11 years with

Type 2 diabetes), results of the study found that only 46.8% of patients achieved the recommended glycemic control level, and only 41.4% of patients achieved the BP target. Moreover, only 20.5% of all patients achieved both target levels for blood glucose and blood pressure. This study demonstrated the difficulty in clinical practice of achieving concurrent glucose and blood pressure control in diabetic patients.

Elis et al[(83)] evaluated the rate of reaching all glycemic, lipid and blood pressure target levels among diabetic patients (n=41,936) and analyzed the rate of reaching HbA1c < 7.0%, LDL-C < 100 mg/dl and blood pressure < 130/85 mmHg, as well as its association with various demographic and clinical parameters. The study found that only 13% of the patients achieved all three target levels. The parameters which were significantly associated with goal achievement were: compliance to medical treatment for all three parameters (OR 1.56, 95% CI 1.44–1.69, P = 0.0001), male gender (OR 1.42, 95% CI 1.31–1.54, P = 0.0001), comorbidity with ischemic heart disease (OR 1.23, 95% CI 1.13–1.34, P = 0.0001), and > 12 visits per year to family physician (OR 1.10, 95% CI 1.02–1.19, P = 0.012).

**In the Arab World**

In Saudi Arabia, a cross-sectional study was conducted in two centers, the King Abdulaziz University Hospital and the Erfan and Bageddo Hospital, to determine the level of blood sugar control in 200 patients (one hundred patients from each hospital) attending out-patient clinics in both hospitals. Results showed that the mean HbA1c was almost the same in both groups (7.8+ / -1.8 mmol/L), and good and acceptable HbA1c was observed in 58% at the KAUH

group versus 54% at the Erfan group. The blood pressure target control was good in both groups; however, target LDL-cholesterol was statistically better in the Efran group (1.88+/-1.2) versus (3.22+/-9 mmol/L) in the KAUH group with a significant p value of 0.0001. The low rate of aspirin use among the diabetic patients was observed more in the KAUH group compared to the Efran group. Patients in both hospitals have not achieved the target level of HbA1c glycated hemoglobin [(84)].

Another study performed at the King Abdul Aziz University Hospital in Saudi Arabia studied 404 diabetic patients (mean age was 53.39 years) attending medical clinics from June 1998 to January 2000. Diabetes mellitus was diagnosed according to the World Health Organization while the target levels studied were in accordance with those of the American Diabetes Association guidelines. The results showed that 40 patients (10%) had type 1 diabetes mellitus and 364 (90%) had type 2 diabetes, with a mean duration of 9.8 ± 7.8 years. A predominance of females was noticed in the sample studied; the male to female ratio was 148:256 (1:1.7). Other results showed that there were 182 (45%) patients with hypertension, while serum lipids were assessed in 259 (64%) patients. The remaining patients were not known to have dyslipidemia and their serum lipids have not been assessed for more than 2 years. The study also showed that there was a significantly lower prevalence of females reaching target levels for blood glucose, BMI, LDL cholesterol, and all targets compared with the males [(85)].

In a study conducted at the South Hawalli Primary Health Care Center in Kuwait[(86)], the results showed that out of the 256 adult subjects (44.5% were women and 55.5% were men), the mean BMI was 32.56 ± 5.85 kg/m$^2$ among

women and 27.83 ± 4.84 kg/m$^2$ in men, while obesity was found in 44.7% (114/255) of patients whereas 33.7% of (86/255) individuals were overweight. Past history of hypertension was recorded in 46.5% (119/256), ischemic heart disease in 12.9% (33/256) and dyslipidemia in 45.5% (116/255) of the patients. Among men, the most significantly prevalent characteristic was smoking (35.7%) while in women, the most prevalent characteristics were the presence of family history of diabetes in first–degree relatives (81.1%), dieting (68.8%), obesity (71.3%), and dyslipidemia (61.5%). In addition, obesity measured by waist circumference (>102 cm in men and >88 cm in women) was found in 63.2% in patients. Obesity measured by waist to hip ratio (> 0.95 in men and > 0.80 in women) was found in 71.3% in patients. Almost a third of the patients were within the acceptable range for glycosylated hemoglobin HbA1c values, while the rest (67%) were in need of additional intervention to improve their glycemic control. High levels of total cholesterol, triglycerides, and low-density lipoprotein (LDL-cholesterol) were found in 48%, 27% and 72% of the patients, respectively. High-density lipoprotein (HDL-cholesterol) levels were found to be abnormal in 60% and 31% among females and males respectively. The metabolic syndrome in diabetic subjects was found to be 33.9% according to the ATP III criteria.

### At the National Center for Diabetes, Endocrinology and Genetics in Amman, Jordan

A study conducted in 2007 enrolled 1,000 diabetic patients attending the clinics at the National Center for Diabetes, Endocrinology and Genetics with the aim of evaluating glycemic control and associated factors in type 2 diabetes patients. The mean age of this studied population was 58 years, with an average duration

of diabetes of 9.4 years (SD=7.2 years). Outcome results showed that only 27.7 % had HbA1c < 7% levels. Glycemic control improved significantly between the first clinic visit and at a 12-month follow-up. The proportion of patients with extreme HbA1c (≥ 10%) decreased from 15.3% to 6.0% after 12 months. The percentage of patients with optimal control (HbA1c < 7%) increased from 25.4 at the first visit to 27.5% at the 12 month follow-up.[87]

Another study that was conducted by Mubarak and colleagues [88] of 1,000 type 2 diabetic patients found that the prevalence of hypertension (BP > 130/80 or on medication for high blood pressure) was 72.4% (70.9% in males and 73.9% in females). The logistic regression indicated that hypertension was positively associated with age (p=.001), body mass index (p=.001) and duration of diabetes (p=.001). About one-half of the patients were not aware of having hypertension. Other studies also had similar outcome results with poor glycemic control.[89]

A study on the prevalence of dysplipidemia in patients with type 2 diabetes was also done by Abdel-Aal et al [90] and found out that over 90% of the patients with type 2 diabetes had one or more types of dyslipidemia. The most common dyslipidemia was high LDL-C (91.5%) and high triglycerides (83.1%).

Based on the results of the studies mentioned, it seemed that a huge proportion of diabetic patients in different parts of the world had inadequate glycemic control and are at high risk of diabetic complications.

## Management of Diabetes Mellitus

Because of the constellation of CVD risk factors that occur with type 2 diabetes, a multiple-risk factor approach, which includes self-management education, lifestyle modification through diet and physical activity, and medical intervention, is required for optimal treatment.(91) Treating only hyperglycemia is not enough; treatment of obesity, dyslipidemia, and hypertension are also needed to considerably reduce CVD risk among those with type 2 diabetes.(92,93)Thus, the American Diabetes Association treatment goals(60) for the prevention of diabetes complications aim to achieve the following goals in metabolic control:

1. Glycemia (HbA1c < 7%)
2. Blood pressure ( BP < 130/80 mmHg)
3. Lipid (LDL-cholesterol < 100 mg/dl)

Glycosylated hemoglobin (HbA1c), a glycemia measure representing average blood glucose concentrations over the previous 8 to 12 weeks, provides a more accurate impression of glycemic control than simply using FPG concentration.(94)Individuals with type 2 diabetes have been advised to maintain their HbA1c at < 7% (94) but fewer than 50% currently achieve this target.(95)More recently, guidelines for normoglycemic control have been reduced to HbA1c ≤ 6.5% (96,94,97)or even as low as < 6% while avoiding hypoglycemic events(92)to substantially reduce CVD risk. Further, in the ADA's most recent "Standards of Medical Care" statement(30), HbA1c ≥ 6.5% was added as a criterion for diagnosis of diabetes and HbA1c 5.7 – 6.4% as a category of increased risk for diabetes.(93)

The majority of individuals with type 2 diabetes have hypertension, and it is estimated that more than 65% of them may need two or more different anti-hypertensive drugs to achieve the ADA target.[92] Hypertension is considered a major risk factor for both CVD and microvascular complications.[94] For this reason, the ADA's treatment recommendations include BP monitoring at each routine diabetes visit, with the goal of achieving the targets, systolic BP < 130 and diastolic BP < 80 mmHg.

Because LDL-C concentrations have shown the strongest and clearest associations with CAD[98], LDL-C lowering is the primary lipid target for individuals with type 2 diabetes with a target set at < 100 mg/dl.[98] Evidence suggests that pharmacotherapy aimed at lowering LDL-C can show important clinical benefits in those with type 2 diabetes,[98] reducing CVD events in those with or without established CVD.[99,100,101] Nonetheless, coronary atherosclerosis in type 2 diabetes has been shown to be primarily driven by a pattern of low HDL-C, high TG, and small dense LDL,[102] and normalizing low HDL-C has been estimated to reduce CVD mortality by 42% in women and 23% in men.[103]

Unfortunately, the percentage of individuals with type 2 diabetes achieving recommended targets for blood lipids has been low at 36% for LDL-C, 27% for HDL-C, and 65% for TG. [95]

# CHAPTER THREE

# METHODOLOGY

## Study Design

A cross sectional retrospective study

## Setting

NCDEG was established in Amman in 1996.It is a specialized center for the treatment, training, development and research in the field of diabetes, endocrinology and genetics. It is considered to be the first and the only specialized center for the care and management of patients with diabetes and referred from all over the kingdom, either directly or from other clinics in the kingdom. The standard of care in the Center demand one visit every 2-3 months. Routine measurement of HbA1c, blood pressure, weight, height, waist circumference, urine examination for microalbuminuria, foot screening and fundoscopy are carried out each visit. Education and dietary counseling are performed to every patient by the treating physician. Those who are receiving insulin therapy are usually referred to the educator clinic. Obese and uncontrolled diabetic patients are usually referred to the dietitian clinic. In addition, there are several specialized clinics related to the complications of diabetes in the center

## Study Population and Sample

The study population includes all patients visiting the diabetes clinic. The medical records of all patients who visited the clinic from December 2010 to March 2011 were reviewed. (n=1576).

The medical records of the patients in the NCDEG includes the nursing notes, which include the blood pressure, height, weight, waist circumference, pulse rate, the abdominal circumference, current medications, any history of hypoglycemia, the presence of lipohypertrophy and foot screening .The nursing notes are followed by the physician‘s notes using the SOAP method (S:Subjective, O:Objective,A:Assessment, P:Plan). In addition a dilated fundoscopic examination is conducted by the treating physician at each visit. The physician note in the medical record is followed by the laboratory records of the patient. Finally, the drug history from the Pharmacy Department for every patient is included in the medical record

## Inclusion and Exclusion Criteria

### Inclusion Criteria

This study was limited to the medical records of patients who met the following criteria:

1. Type 2 diabetic patients who attended the outpatient clinics at the National Center of Diabetes, Endocrinology and Genetics from December 2010 to March 2011.
2. The patients’ age should be more than 25 years.

3. The patient should have more than 4 regular visits in the last year to the center (visit every two to three months) and at least one year follow up in the center.

## Exclusion Criteria

Patients with type 1 diabetes and pregnant women were excluded from the study

## Data Collection

Data were collected over a period of four months from December 2010 to March 2011. Extracted data were recorded on the data collection sheet developed by the researcher. The data sheet was designed to collect demographic characteristics of the patients such as patient's file number, gender, height, weight, hemoglobin A1c level, lipid profile results, blood glucose levels, medications used, co-morbidities, complications of diabetes , dietitian clinic visits and health educator clinic visits.

## Anthropometric Measurements

The anthropometric measurements for this study include weight, height, and waist circumference. These measurements are routinely taken for each patient in each visit by a nurse ,with patients wearing light clothing and no shoes. Waist circumference was measured to the nearest centimeter by the placement of a non-stretchable measuring tape in a horizontal plane around the abdomen mid-way between the lower border of the ribs and iliac crest. The measurement was made at the end of a normal expiration while ensuring that the tape was snug but without compression the skin ,and was parallel to the floor. Body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters).

Two readings of systolic and diastolic blood pressure were taken from the left arm and the right arm, with the subject seated and the arm at heart level, after at least 5 minutes of rest ,using a standardized mercury sphygmomanometer for each patient in each visit by a nurse. The mean of the two readings was taken as the individual's blood pressure.

## Definition of Study Variables

**First visit:** the first visit made by the patient to the NCDEG.

**Last visit:** the last visit during the follow up period in NCDEG.

**Age (year)**: participants' age was categorized into four groups: group1<50, group2=50-59, group 3=60-69, and group 4 ≥ 70 years.

**Duration of diabetes** at the first visit was defined by years including: duration 1 <5 years, duration 2=5-9.9 years , duration 3=10-14.9 years, and duration 4≥15 years.

**Follow up duration**: The period between the first visit and last visit was categorized into: duration 1≤ 3 years and duration 2> 3 years.

**Glycosylated hemoglobin (HbA1c)**: Glycemic status was considered good if HbA1c <7%, acceptable if HbA1c =7%-8% and poor if HbA1c > 8 %.

**Body mass index (BMI):** classified as the ratio of weight in kilograms to height in square meters. World Health Organization (WHO) criteria for adults were used to classify BMI as follows [104].

- Normal if BMI <25 $Kg/m^2$
- Overweight when BMI between 25-29.9 $Kg/m^2$
- Obese if BMI ≥30 $Kg/m^2$

**Waist circumference**: measured by a nurse in centimeters with a tape measured at the midpoint between the lower part of the last rib and the top of the iliac crest and was classified according to IDF [105].

- Normal if it is < 94 cm for men and < 80 cm for women
- Also (waist/height ratio) was considered normal if it was < 0.5 and abnormal if it was ≥ 0. 5

**Blood pressure:** Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were obtained from records (two readings measured were taken from patient by nurse and the mean value was calculated).

The presence of hypertension was defined as taking antihypertensive agents or a recorded SBP ≥ 130 mmHg and or DBP ≥ 80 mmHg [60].

**Smoking:** According to WHO guidelines [106].

- Current smoker: a person who smokes cigarettes daily or occasionally.
- Past smoker: a person who was formerly a daily or occasional smoker, but currently did not at all.
- Non-smoker: a person who has never smoked before or has smoked very little in the past.

**Dyslipidemia:** if the patients were maintained lipid lowering agents or the presence of one or more abnormal lipid parameters: total cholesterol ≥ 200 mg/dL, LDL cholesterol ≥100 mg/dL, HDL cholesterol ≤ 50 mg/dL for women and ≤ 40 for men, triglycerides ≥ 150 mg/dL [60].

**Coronary heart disease (CHD):** was considered positive if there was a history of CHD (Coronary artery bypass surgery, coronary artery stent, myocardial infarction, angina) or on current treatment for CHD in the medical records.

**Cerebrovascular disease:** was considered positive if there was a history of cerebrovascular disease (stroke or transient ischemic attack**)** in the medical records.

**Chronic kidney disease (CKD):** was considered positive depending on the National Kidney Foundation classification which is primarily based on GFR

levels [60,107] in which staging is based primarily on the urinary albumin excretion (Table 1).

| Table 1. National Kidney Foundation classification for CKD | | |
|---|---|---|
| **Stage** | **Description** | **GFR (ml/min per 1.73 $m^2$ body surface area)** |
| 1 | Kidney damage* with normal or increased GFR | $\geq 90$ |
| 2 | Kidney damage* with mildly decreased GFR | 60–89 |
| 3 | Moderately decreased GFR 30–59 | 30–59 |
| 4 | Severely decreased GFR | 15–29 |
| 5 | Kidney failure | <15 or dialysis |

*Kidney damage defined as abnormalities on pathologic, urine, blood, or imaging tests[108]

**Modifications of diet in renal disease (MDRD)** [109]**:** Study group equation will be used to calculate eGFR: eGFR (mL/min/1.73 $m^2$) = 186.3 × (serum creatinine-1.154) × (age-0.203) × 0.742 (if female) × 1.212 (if black). GFR calculators are available at http//www.nkdep.nih.gov.

**Retinopathy:** was diagnosed positive if it is documented by either the ophthalmologist or the treating physician in the medical records.

**Diabetic foot ulcer**: was considered positive if it was registered in the medical records with a follow up at the diabetic foot clinic.

**Microalbuminuria by dipstick:** was defined positive if there was an elevated level of albumin in the urine in least 2 of 3 samples done in a 3 to 6 month period [60].

At the NCDEG laboratory, the microalbuminuria is considered positive by dipstick if microalbumin in the urine was ≥ 50mg/L.

**Peripheral distal symmetrical neuropathy:** was considered positive if there is a history of peripheral distal symmetrical neuropathy (numbness, tingling, or pain in the toes, feet, legs, hands, arms, and fingers) in the patients' medical records.

**Dietitian clinic visits**: patient had at least one visit to the dietitian clinic during follow up at the NCDEG.

**Health education clinic visits:** patient had at least one visit to the health education clinic during follow up at the NCDEG.

**Laboratory and biochemical determinations:** were performed using the methods standardized by the local laboratory.

**Glycosylated hemoglobin (HbA1c)**: was analyzed using a high-performance liquid chromatography (HPLC) method (Bio-Rad) [110].

**Lipid profile**: was analyzed using the automated spectrophotometer, COBAS INTEGRA, by using commercial kits supplied by Roche Diagnostics [111].

**Plasma creatinine:** was measured by using the automated spectrophotometer, COBAS INTEGRA, by using commercial kits supplied by Roche Diagnostics [111].

**Albuminuria concentrations:** were measured by a urine dipstick supplied by Roche Diagnostics [111].

## Statistical Analysis

The statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 17. Data were screened for extreme outliers, logical inconsistencies and errors. Means, standard deviations (SD) and frequencies were used to describe different parameters. Student paired *t*-test was used to assess the difference in means. The chi-squared test was used to test the statistical differences for categorical variables and if $p \leq 0.05$, it was considered statistically significant. Linear regression was used to measure the independent variables effect related to change in HbA1c, blood pressure and lipid parameters among the patients with type 2 diabetes for the first and last visits.

# CHAPTER FOUR

# RESULTS

## Participants' Characteristics

This study included a total of 1576 type 2 diabetic patients who had more than four regular visits to NCDEG in 2010 (773 males and 803 females). Their age ranged between 29 and 90 years with a mean of 60.8 ± 9.9 years, the mean duration of diabetes was 10.8±7.1 years, and the mean number of visits were15.0±6.0 visits which ranged between 5 and 34 visits.

Table 2 describes the demographic, anthropometric and relevant characteristics of patients in the last visit according to gender. It shows that the percentage of current smokers was significantly higher among males (27.9%) than females (10%). Meanwhile, it was found that obesity was remarkably higher among females (72.2%) than males (45.7%), the overwhelming majority of females (98.7%) had increased waist circumference compared to 77.8% in males ($p < 0.05$).

**Table 2. The demographic, clinical, anthropometric, and relevant characteristics of patients in the last visit according to gender**

| Characteristics | Male N(773) %(49) | | Female N(803) %(51) | | All (1576) %(100) | | P – Value** |
|---|---|---|---|---|---|---|---|
| | n | %* | n | %* | n | %* | |
| **Age ( years)** | | | | | | | 0.599 |
| < 50 | 103 | (13.3) | 96 | (12.0) | 199 | (12.6) | |
| 50-59 | 228 | (29.5) | 259 | (32.3) | 487 | (30.9) | |
| 60-69 | 282 | (36.5) | 292 | (36.4) | 574 | (36.4) | |
| ≥ 70 | 160 | (20.7) | 156 | (19.4) | 316 | (20.1) | |
| Age (years), mean ± SD | 60.8 ± 10.3 | | 60.8 ± 9.7 | | 60.8 ± 9.9 | | 0.906 |
| Age at diagnosis (years), mean ± SD | 50.0 ± 10.3 | | 50.1 ± 10.2 | | 50.1 ± 10.2 | | 0.825 |
| Duration of DM (years), mean ± SD | 10.9 ± 7.0 | | 10.7 ± 7.2 | | 10.8 ± 7.1 | | 0.670 |
| Duration of follow up (years), mean ± SD | 3.43 ± 1.47 | | 3.44 ± 1.50 | | 3.4 ± 1.5 | | 0.918 |
| Number of visits, mean ± SD | 14.96 ± 6.2 | | 15.1 ± 6.2 | | 15.0 ± 6.2 | | 0.695 |
| **Smoking** | | | | | | | 0.000 |
| Current smoker | 198 | (27.9) | 68 | (10.0) | 266 | (19.1) | |
| Past smoker | 139 | (19.6) | 42 | (6.2) | 181 | (13.0) | |
| Non-smoker | 373 | (52.5) | 572 | (83.8) | 945 | (67.9) | |
| **BMI** (Kg/m$^2$) | | | | | | | 0.000 |
| Normal <25 | 98 | (12.9) | 46 | (5.9) | 144 | (9.4) | |
| Overweight 25-29.9 | 316 | (41.4) | 170 | (21.9) | 486 | (31.5) | |
| Obese ≥30 | 349 | (45.7) | 562 | (72.2) | 911 | (59.1) | |
| **Waist circumference (cm)** | | | | | | | 0.000 |
| Normal M<94 F<80 | 170 | (22.2) | 10 | (1.3) | 180 | (11.6) | |
| Increased M≥94 F≥80 | 596 | 77.8 | 779 | (98.7) | 1375 | (88.4) | |
| **Waist height ratio** | | | | | | | 0.001 |
| Normal <0.5 | 20 | (2.6) | 4 | (0.5) | 24 | (1.6) | |
| Increased ≥0.5 | 741 | (97.4) | 773 | (99.5) | 1514 | (98.4) | |

***Percentage within gender**

**** P-value refer to the difference between males and females**

**Categories of some variables do not add to the total number because of missing values**

## Clinical Characteristics and Diabetes Complications in Patients with Type 2 Diabetes in the Last Visit According to Gender

Table 3 shows the clinical characteristics and diabetes complications of patients with type 2 diabetes in the last visit according to gender. According to the table, 92.8% of study subjects were hypertensive, while 96.3% were dyslipidemic, 16.8% had CHD, 4.1% were having stroke, 32.9% were having retinopathy, 5.2% were having diabetic foot ulcers, 55.4% were having symptomatic neuropathy, 30.7% were having microalbuminuria, 15% were having stage 1 chronic kidney disease, 8.9% were having stage 2 chronic kidney disease, 12.4% were having stage 3 chronic kidney disease, 0.7% were having stage 4 chronic kidney disease, and 0.01% were having stage 5 chronic kidney disease. There were no statistically significant differences between males and females regarding the frequency of hypertension, dyslipidemia, stroke, retinopathy and neuropathy ($p>0.05$). On the other hand, it was noted that the prevalence of CHD, diabetic foot ulcers and microalbuminuria were significantly higher among males (20.8%, 6.5% and 33.3%, respectively) than females (12.8%, 6.5% and 28.2%, respectively) with statistically significant p value.

**Table 3. Clinical characteristics and diabetes complications of patients with type 2 diabetes in the last visit according to gender**

| **Characteristics** | | **Male N(773) %(49)** | | **Female N(803) %(51)** | | **All N(1576) %(100)** | | **P – Value **** |
|---|---|---|---|---|---|---|---|---|
| | | **n** | **%*** | **n** | **%*** | **n** | **%*** | |
| Hypertension | Yes | 711 | **(92.0)** | 752 | **(93.6)** | 1463 | (92.8) | 0.199 |
| | No | 62 | (8.0) | 51 | (6.4) | 113 | (7.2) | |
| Dyslipidemia | Yes | 742 | **(96.0)** | 775 | **(96.5)** | 1517 | (96.3) | 0.584 |
| | No | 31 | (4.0) | 28 | (3.5) | 59 | (3.7) | |
| Coronary heart disease | Yes | 161 | (20.8) | 103 | (12.8) | 264 | (16.8) | 0.000 |
| | No | 612 | (79.2) | 700 | (87.2) | 1312 | (83.2) | |
| Stroke | Yes | 35 | (4.5) | 29 | (3.6) | 64 | (4.1) | 0.354 |
| | No | 736 | (95.5) | 773 | (96.4) | 1509 | (95.9) | |
| Retinopathy | Yes | 251 | (32.9) | 262 | (33.0) | 513 | (32.9) | 0.098 |
| | No | 512 | (67.1) | 533 | (67.0) | 1045 | (67.1) | |
| Neuropathy | Yes | 405 | (54.1) | 440 | (56.6) | 845 | (55.4) | 0.344 |
| | No | 343 | (45.9) | 338 | 43.4 | 681 | (44.6) | |
| Diabetic foot ulcer | Yes | 50 | (6.5) | 32 | (4.0) | 82 | (5.2) | 0.026 |
| | No | 723 | (93.5) | 771 | (96.0) | 1494 | (94.8) | |
| Microalbuminuria | Positive | 255 | (33.3) | 225 | (28.2) | 480 | (30.7) | 0.030 |
| | negative | 511 | (66.7) | 572 | (71.8) | 1083 | (69.3) | |
| Chronic kidney disease | Normal | 440 | (60.3) | 496 | (65.3) | 936 | (62.9) | 0.167 |
| | Stage 1 | 120 | (16.4) | 104 | (13.7) | 224 | (15.0) | |
| | Stage 2 | 74 | (10.1) | 59 | (7.8) | 133 | (8.9) | |
| | Stage 3 | 89 | (12.2) | 95 | (12.5) | 184 | (12.4) | |
| | Stage 4 | 5 | (0.7) | 5 | (0.7) | 10 | (0.7) | |
| | Stage 5 | 2 | (0.3) | 0 | (0.0 ) | 2 | (0.1) | |

***Percentage within gender**

**** P-value refer to the difference between males and females**

**Categories of some variables do not add to the total number because of missing values**

## The Glycemic and Metabolic Control Among Patients with Type 2 Diabetes in the Last Visit According to Gender

Table 4 shows the glycemic and metabolic control in addition to blood pressure control among patients with type 2 diabetes in the last visit according to gender. The control of systolic blood pressure and the control of the metabolic parameters namely; HbA1c, total cholesterol, LDL cholesterol and HDL cholesterol were significantly better among males than females ($p<0.05$). Meanwhile, there were no significant differences between males and females regarding the control of diastolic blood pressure and the control of hyper-triglyceridemia ($p>0.05$).

**Table 4. The glycemic and metabolic control among patients with type 2 diabetes in the last visit according to gender**

| Characteristics | | Male N(773) %(49) | | Female N(803) %(51) | | All (1576) %(100_ | | P – Value** |
|---|---|---|---|---|---|---|---|---|
| | | N | %* | N | %* | N | %* | |
| Systolic BP (mmHg) | <130 | 290 | (37.5) | 255 | (31.9) | 545 | (34.7) | 0.020 |
| | ≥130 | 483 | (62.5) | 544 | (68.1) | 1027 | (65.3) | |
| Diastolic BP (mmHg) | <80 | 482 | (62.4) | 507 | (63.5) | 989 | (62.9) | 0.652 |
| | ≥80 | 291 | (37.6) | 292 | (36.5) | 583 | (37.1) | |
| Blood pressure control (mmHg) | systolic<130 and diastolic<80 | 229 | (29.6) | 205 | (25.7) | 434 | (27.6) | 0.079 |
| | systolic≥130 and or diastolic≥80 | 544 | (70.4) | 594 | (74.3) | 1138 | (72.4) | |
| HbA1c (%) | <7 | 316 | (40.9) | 287 | (35.7) | 603 | (38.3) | 0.002 |
| | 7-8 | 293 | (37.9) | 284 | (35.4) | 577 | (36.6) | |
| | >8 | 164 | (21.2) | 232 | (28.9) | 396 | (25.1) | |
| Total cholesterol (mg/dl) | <200 | 686 | (92.1) | 646 | (83.5) | 1332 | (87.7) | 0.000 |
| | ≥200 | 59 | (7.9) | 128 | (16.5) | 187 | (12.3) | |
| LDL cholesterol (mg/dl) | <100 | 527 | (70.2) | 500 | (64.2) | 1027 | (67.1) | 0.013 |
| | ≥100 | 224 | (29.8) | 279 | (35.8) | 503 | (32.9) | |
| HDL cholesterol (mg/dl) | F>50 M>40 | 317 | (42.3) | 275 | (35.3) | 592 | (38.7) | 0.005 |
| | F≤50 M≤40 | 432 | (57.7) | 504 | (64.7) | 936 | (61.3) | |
| Triglycerides (mg/dl) | <150 | 408 | (54.1) | 425 | (54.5) | 833 | (54.3) | 0.883 |
| | ≥150 | 346 | (45.9) | 355 | (45.5) | 701 | (45.7) | |

***Percentage within gender**

**** P-value refer to the difference between the gender**

**Categories of some variables do not add to the total number because of missing values**

## The Dietitian Clinic Visits and Education Clinic Visits Among Patients with Type 2 Diabetes up to the Last Visit According to Gender

Table 5 shows the dietitian clinic visits and education clinic visits among patients with type 2 diabetes up to the last visit according to gender. Only 7.6 % of the study population have attended the dietitian clinics and only 11.7 % of the study population have attended the education clinic. More females have visited the dietitian clinic than males (p=**0.000).**

**Table 5. The dietitian clinic visits and education clinic visits among patients according to gender**

| **Characteristics** | | **Male N(773) %(49)** | | **Female N(803) %(51)** | | **All N(1576) %(100)** | | **P – Value**** |
|---|---|---|---|---|---|---|---|---|
| | | **N** | **%*** | **N** | **%*** | **N** | **%*** | |
| Dietitian clinic visits | Yes | 40 | (5.2) | 80 | (10) | 120 | (7.6) | 0.000 |
| | No | 733 | (94.8) | 723 | (90) | 1456 | (92.4) | |
| Education clinic visits | Yes | 89 | (11.5) | 95 | (11.8) | 184 | (11.7) | 0.845 |
| | No | 684 | (88.5) | 708 | (88.2) | 1392 | (88.3) | |

***Percentage within gender**

**** P-value refers to the difference between males and females**

## The Demographic, Clinical, Anthropometric, and Relevant Characteristics in Patients with Type 2 Diabetes in the Last Visit According to HbA1c Level

Table 6 shows the demographic, clinical, anthropometric, and relevant characteristics of patients with type 2 diabetes in the last visit according to HbA1c level. 38.3% of the study population were having HbA1c <7%, 36.6% of the study population were having HbA1c between 7% and 8% and 25.1% of study population were having HbA1c >8%.

There was no statistically significant difference in diabetes control in all age groups, and the control of HbA1c was not related to the duration of follow up . It was noticed that the majority of uncontrolled diabetic patients were obese and overweight ($p<0.05$), and the majority of uncontrolled diabetics are having elevated waist circumference with statistically significant p value ($p<0.05$).It was noticed that patients with longer duration of diabetes were more likely to have uncontrolled diabetes.

**Table 6.The demographic, clinical, anthropometric, and relevant characteristics in patients with type 2 diabetes in the last visit according to HbA1c level**

| **Characteristics** | **HbA1c< 7 N(603) %(38.3)** | | **HbA1c 7-8 N(577) %(36.6)** | | **HbA1c>8 N(396) %(25.1)** | | **P – Value**** |
|---|---|---|---|---|---|---|---|
| | **N** | **%*** | **N** | **%*** | **N** | **%*** | |
| **Age ( years)** | | | | | | | 0.729 |
| < 50 | 78 | (12.9) | 65 | (11.2) | 56 | (14.1) | |
| 50-59 | 180 | (29.9) | 184 | (31.9) | 123 | (31.1) | |
| 60-69 | 220 | (36.5) | 207 | (35.9) | 147 | (37.1) | |
| ≥ 70 | 125 | (20.7) | 121 | (21.0) | 70 | (17.7) | |
| Age (years), mean ± SD | 60.9 ± 10.2 | | 60.9 ± 9.8 | | 60.4 ± 9.9 | | 0.705 |
| Age at diagnosis(years), mean ± SD | 52.3 ± 10.1 | | 49.5 ± 9.9 | | 47.5. ± 10.0 | | 0.000 |
| Duration of DM(years), mean ± SD | 8.6 ± 6.5 | | 11.5 ± 6.7 | | 12.9 ± 7.5 | | 0.000 |
| Duration of DM(years) | | | | | | | 0.000 |
| < 5 | 212 | (35.5) | 74 | (12.9) | 36 | (9.3) | |
| 5-9 | 179 | (29.9) | 189 | (33.0) | 118 | (29.9) | |
| 10-14 | 101 | (16.9) | 153 | (26.7) | 99 | (25.1) | |
| ≥ 15 | 106 | (17.7) | 157 | (27.4) | 141 | (35.7) | |
| Duration of follow up(years), mean ± SD | 3.4 ± 1.5 | | 3.5 ± 1.5 | | 3.4 ± 1.5 | | 0.114 |
| Duration of follow up(years), | | | | | | | 0.157 |
| ≤ 3 | 305 | (50.6) | 260 | (45.1) | 186 | (47.0) | |
| > 3 | 298 | (49.4) | 317 | (54.9) | 210 | (53.0) | |
| Number of visits, mean ± SD | 14.6 ± 5.9 | | 15.2 ± 6.1 | | 15.3± 6.3 | | 0.089 |
| **Smoking** | | | | | | | 0.273 |
| Current smoker | 110 | (20.7) | 92 | (17.8) | 64 | (18.5) | |
| Past smoker | 79 | (14.8) | 59 | (11.5) | 43 | (12.5) | |
| Non-smoker | 343 | (64.5) | 364 | (70.7) | 238 | (69.0) | |
| **BMI**(Kg/m$^2$) | | | | | | | 0.000 |
| Normal <25 | 73 | (12.4) | 53 | (9.4) | 18 | (4.6) | |
| Overweight 25-29.9 | 219 | (37.0) | 184 | (32.8) | 83 | (21.4) | |
| Obese ≥30 | 299 | (50.6) | 325 | (57.8) | 287 | (74.0) | |
| **Waist circumference (cm)** | | | | | | | 0.000 |
| Normal M<94 F<80 | 98 | (16.4) | 57 | (10.0) | 25 | (6.4) | |
| Increased M≥94 F≥80 | 498 | (83.6) | 511 | (90.0) | 366 | (93.6) | |
| **Waist height ratio** | | | | | | | 0.201 |
| Normal <0.5 | 13 | (2.2) | 8 | (1.4) | 3 | (0.8) | |
| Increased ≥0.5 | 578 | (97.8) | 553 | (98.6) | 384 | (99.2) | |

***Percentage within glycemic control**

**** P-value refer to the difference between those who are having HbA1c <7%, HbA1c 7-8 % and HbA1c>8%**

**Categories of some variables do not add to the total number because of missing values**

## Clinical Characteristics and Diabetes Complications of Patients with Type 2 Diabetes in the Last Visit According to HbA1c Level

Table 7 shows the clinical characteristics and diabetes complications in patients with type 2 diabetes in the last visit according to HbA1c level. It was found that dyslipidemia, retinopathy, CHD, CKD, neuropathy and microalbuminuria were significantly more prevalent among the uncontrolled diabetic patients (HbA1c >7%) with statistically significant p value. However, no statistically significant difference was detected between controlled and uncontrolled diabetic patients regarding the presence of hypertension, stroke and diabetic foot ulcers ($p>0.05$).

**Table 7. Clinical characteristics and diabetes complications of patients with type 2 diabetes in the last visit according to the glycemic control in terms of HbA1c level**

| Characteristics | | HbA1c < 7 N(603) %(38.3) | | HbA1c 7-8 N(577) %(36.6) | | HbA1c >8 N(396) %(25.1) | | P – Value** |
|---|---|---|---|---|---|---|---|---|
| | | N | %* | N | %* | N | %* | |
| Hypertension | Yes | 551 | (91.4) | 563 | (92.9) | 376 | (94.9) | 0.101 |
| | No | 52 | (8.6) | 41 | (7.1) | 20 | (5.1) | |
| Dyslipidemia | Yes | 567 | (94.0) | 562 | (97.4 | 338 | (98.0) | 0.001 |
| | No | 36 | (6.0) | 15 | (2.6) | 8 | (2.0) | |
| Coronary heart disease | Yes | 90 | (14.9) | 90 | (15.6) | 84 | (21.2) | 0.022 |
| | No | 513 | (85.1) | 487 | (84.4) | 312 | (78.8) | |
| Stroke | Yes | 25 | (4.2) | 19 | (3.3) | 20 | (5.1) | 0.390 |
| | No | 575 | (95.8) | 558 | (96.7) | 376 | (94.9) | |
| Retinopathy | Yes | 127 | (21.3) | 208 | (36.4) | 178 | (45.5) | 0.000 |
| | No | 469 | (78.7) | 363 | (63.6) | 213 | (54.5) | |
| Neuropathy | Yes | 290 | (49.7) | 317 | (56.7) | 238 | (62.1 | 0.000 |
| | No | 294 | (50.3) | 242 | (43.3) | 145 | (37.9) | |
| Diabetic foot ulcer | Yes | 24 | (4.0) | 33 | (5.7) | 25 | (6.3) | 0.209 |
| | No | 579 | (69.0) | 544 | (94.3) | 371 | (93.7) | |
| Microalbuminuria | Positive | 161 | (27.0) | 172 | (30.1) | 147 | (37.2) | 0.003 |
| | negative | 436 | (73.0) | 399 | (69.9) | 248 | (62.8) | |
| Chronic kidney disease | Normal | 366 | (64.5) | 362 | (65.6) | 208 | (56.0) | 0.013 |
| | Stage 1 | 72 | (12.7) | 79 | (14.3) | 73 | (19.7) | |
| | Stage 2 | 56 | (9.9) | 51 | (9.3) | 26 | (7.0) | |
| | Stage 3 | 69 | (12.2) | 56 | (10.2) | 59 | (15.9) | |
| | Stage 4 | 4 | (0.7) | 2 | (0.4) | 4 | (1.1) | |
| | Stage 5 | 0 | (0.0) | 1 | (0.2) | 1 | (0.3) | |

***Percentage within glycemic control**

**** P-value refer to the difference between those who are having HbA1c <7%, HbA1c 7-8% and HbA1c >8%**

**Categories of some variables do not add to the total number because of missing values**

## The Blood Pressure and Metabolic Control Among Patients with Type 2 Diabetes in the Last Visit According to HbA1c Level

Table 8 shows the blood pressure and metabolic control among patients with type 2 diabetes in the last visit according to the glycemic control defined by level of HbA1c.It was found that uncontrolled diabetic patients are significantly more prone to have uncontrolled diastolic pressure, hypercholesterolemia, high LDL cholesterol, low HDL cholesterol and hypertriglyceridesmia ($p<0.05$). However, there was no significant differences between controlled and uncontrolled diabetic patients regarding systolic blood pressure control ($p>0.05$).

| **Table 8. The blood pressure and metabolic control among patients with type 2 diabetes in the last visit according to HbA1c** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Characteristics** | | **HbA1c< 7 N(603) %(38.3)** | | **HbA1c 7-8 N(577) %(36.6)** | | **HbA1c>8 N(396) %(25.1)** | | **P - Value**** |
| | | **N** | **%*** | **N** | **%*** | **N** | **%*** | |
| Systolic BP (mmHg) | <130 | 225 | (37.4) | 187 | (32.5) | 133 | (33.6) | 0.182 |
| | ≥130 | 376 | (62.6) | 388 | (67.5) | 263 | (66.4) | |
| Diastolic BP (mmHg) | <80 | 420 | (69.9) | 336 | (58.4) | 233 | (58.8) | 0.000 |
| | ≥80 | 181 | (30.1) | 239 | (41.6) | 163 | (41.2) | |
| Blood pressure control (mmHg) | systolic<130 and diastolic<80 | 194 | (32.3) | 142 | (24.7.) | 98 | (24.7) | 0.005 |
| | systolic≥130 and or diastolic≥80 | 407 | (67.7) | 433 | (75.3) | 298 | (75.3) | |
| Total cholesterol (mg/dl) | <200 | 532 | (90.6) | 482 | (86.5) | 318 | (84.8) | 0.016 |
| | ≥200 | 55 | (9.4) | 75 | (13.5) | 57 | (15.2) | |
| LDL cholesterol (mg/dl) | <100 | 420 | (71.1) | 361 | (64.3) | 246 | (65.1) | 0.033 |
| | ≥100 | 171 | (28.9) | 200 | (35.7) | 132 | (34.9) | |
| HDL cholesterol (mg/dl) | F>50 M>40 | 273 | (46.3) | 202 | (36.0) | 117 | (31.0) | 0.000 |
| | F≤50 M≤40 | 317 | (53.7) | 459 | (64.0) | 260 | (69.0) | |
| Triglycerides (mg/dl) | <150 | 368 | (62.2) | 288 | (51.2) | 177 | (46.7) | 0.000 |
| | ≥150 | 224 | (37.8) | 275 | (48.8) | 202 | (53.3) | |

***Percentage within glycemic control**

**** P-value refer to the difference between those who are having HbA1c <7%, HbA1c 7-8% and HbA1c>8%**

**Categories of some variables do not add to the total number because of missing values**

## The Dietitian and Education Clinic Visits Among Patients with Type 2 Diabetes up to the Last Visit According to HbA1c Level

Table 9 shows the dietitian clinic visits and education clinic visits among patients according to HbA1c level. It was noticed that the uncontrolled diabetic patients were more likely to visit the education clinic

**Table 9. The dietitian clinic visit and education clinic visit among type 2 diabetic patients up to the last visit according to HbA1c level**

| **Characteristics** | | **HbA1c<7** | | **HbA1c 7-8** | | **HbA1c>8** | | **P – Value**** |
|---|---|---|---|---|---|---|---|---|
| | | **N** | **%*** | **N** | **%*** | **N** | **%*** | |
| Dietitian clinic visits | Yes | 46 | (7.6) | 39 | (6.8) | 35 | (8.8) | 0.468 |
| | No | 557 | (92.4) | 538 | (93.2) | 361 | (91.2) | |
| Education clinic visits | Yes | 89 | (5.3) | 71 | (12.3) | 81 | (20.5) | 0.000 |
| | No | 571 | (94.7.) | 506 | (87.7) | 315 | (79.5) | |

***Percentage within glycemic control**

**** P-value refer to the difference between those who are having HbA1c <7%, HbA1c 7-8% and HbA1c>8%**

## The Clinical Characteristics and Diabetes Complications in Patients with Type 2 Diabetes Between the First and the Last Visit

Table 10 shows the clinical characteristics and diabetes complications of patients between the first and the last visit. There was a significant increase in the prevalence of hypertension, dyslipidemia, CHD, retinopathy, stroke and diabetic foot ulcers ($p<0.05$). Furthermore, there was significant reduction in the prevalence of microalbuminuria ($p<0.05$).

**Table 10. The clinical characteristics and diabetes complications among patients with type 2 diabetes between the first and the last visit to NCDEG**

| **Characteristics** | | **First visit** | | **Last visit** | | **P – Value** |
|---|---|---|---|---|---|---|
| | | **N(1576)** | **%** | **N(1576)** | **%** | |
| Hypertension | Yes | 1272 | (80.7) | 1463 | (92.8) | 0.000 |
| | No | 304 | (19.3) | 113 | (7.2) | |
| Dyslipidemia | Yes | 1437 | (92.4) | 1499 | (96.3) | 0.000 |
| | No | 119 | (7.6) | 57 | (3.7) | |
| Coronary heart disease | Yes | 175 | (11.1) | 264 | (16.8) | 0.000 |
| | No | 1401 | (88.9) | 1312 | (83.2) | |
| Stroke | Yes | 39 | (2.5) | 64 | (4.1) | 0.000 |
| | No | 1524 | (97.5) | 1499 | (95.9) | |
| Retinopathy | Yes | 309 | (19.9) | 510 | (32.8) | 0.000 |
| | No | 1246 | (80.1) | 1045 | (67.2) | |
| Neuropathy | Yes | 600 | (40.3)) | 823 | (55.3) | 0.000 |
| | No | 887 | (59.7) | 664 | (44.7) | |
| Diabetic foot ulcer | Yes | 50 | (3.2) | 82 | (5.2) | 0.000 |
| | No | 1526 | (96.8) | 1494 | (94.8) | |
| Microalbuminuria | Positive | 560 | (35.9) | 478 | (30.7) | 0.000 |
| | negative | 998 | (64.1) | 1080 | (69.3) | |
| Chronic kidney disease | Normal | 888 | (61.4) | 912 | (63.1) | 0.000 |
| | Stage 1 | 314 | (21.7) | 216 | (14.9) | |
| | Stage 2 | 150 | (10.4) | 128 | (8.9) | |
| | Stage 3 | 89 | (6.2) | 178 | (12.3) | |
| | Stage 4 | 5 | (0.3) | 10 | (0.7) | |
| | Stage 5 | 0 | (0.0) | 2 | (0.1) | |

**Categories of some variables do not add to 1576 because of missing values**

## The Glycemic and Metabolic Control Among Patients with Type 2 Diabetes Between the First and the Last Visit

Table 11 shows the differences in the glycemic and metabolic control among the study population between the first and the last visit. There were significant improvements in the glycemic control, diastolic blood pressure, total cholesterol and LDL cholesterol among patients between the first and the last visit to NCDEG ($p<0.05$).

**Table 11. The differences in glycemic and metabolic control among patients with type 2 diabetes between the first and the last visit to NCDEG**

| Characteristics | | First visit | | Last visit | | P – Value |
|---|---|---|---|---|---|---|
| | | **N(1576)** | **%** | **N(1576)** | **%** | |
| HbA1c (%) | < 7 | 320 | (20.3) | 603 | (38.3) | 0.000 |
| | 7-8 | 405 | (25.7) | 577 | (36.6) | |
| | >8 | 851 | (54.0) | 396 | (25.1) | |
| Systolic BP (mmHg) | < 130 | 690 | (39.9) | 544 | (34.6) | 0.000 |
| | ≥130 | 880 | (56.1) | 1026 | (65.4) | |
| Diastolic BP (mmHg) | < 80 | 659 | (42.0) | 987 | (62.9) | 0.000 |
| | ≥ 80 | 910 | (58.0) | 582 | (37.1) | |
| Blood pressure control (mmHg) | systolic<130 and diastolic<80 | 471 | (30.0) | 433 | (27.6) | 0.000 |
| | systolic≥130 and or diastolic≥80 | 1099 | (70.0) | 1137 | (72.4) | |
| Total cholesterol (mmHg) | < 200 | 1116 | (68.6) | 1304 | (88.1) | 0.000 |
| | ≥ 200 | 464 | (31.4) | 176 | (11.9) | |
| LDL cholesterol (mmHg) | < 100 | 518 | (34.8) | 1004 | (67.4) | 0.000 |
| | ≥ 100 | 971 | (65.2) | 485 | (32.6) | |
| HDL cholesterol (mg/dl) | F > 5o M > 40 | 678 | (45.5) | 575 | (38.6) | 0.000 |
| | F ≤ 50 M≤ 40 | 811 | (54.5) | 914 | (61.4) | |
| Triglycerides (mg/dl) | < 150 | 738 | (49.4) | 813 | (54.4) | 0.000 |
| | ≥ 150 | 756 | (50.6) | 681 | (45.6) | |

**Categories of some variables do not add to 1576 because of missing values**

## The Differences in HbA1c, Blood Pressure and Lipid Parameters Among Study Population Between the First and the Last Visit After Adjustment for Duration of Diabetes and Years of Follow Up

Table 12 shows that there were significant improvements in HbA1c, diastolic blood pressure, total cholesterol, triglycerides and LDL cholesterol between the first visit and last visit ($p<0.05$). Nevertheless, there was no statistically significant improvement in systolic blood pressure among the patients between the first and the last visit after adjustment for the duration of diabetes and years of follow up ($p>0.05$).

**Table 12. The differences in HbA1c, blood pressure and lipid parameters among the patients with type 2 diabetes between the first and the last visits adjustment for duration of diabetes and years of follow up**

| Characteristics | First visit | Last visit | P value |
|---|---|---|---|
| | **Mean ± SD** | **Mean ± SD** | |
| HbA1c (%) | 8.64 ± 1.99 | 7.43 ± 1.21 | <0.005 |
| Systolic BP(mmHg) | 131.32 ± 20.36 | 134.31 ± 18.06 | 0.052 |
| Diastolic BP(mmHg) | 78.48 ± 10.81 | 73.74 ± 9.43 | <0.005 |
| Total cholesterol(mg/dl) | 183.92 ± 40.57 | 160.92 ± 34.71 | <0.005 |
| LDL cholesterol(mg/dl) | 117.13 ± 34.11 | 91.74 ± 27.61 | <0.005 |
| HDL cholesterol(mg/dl) | 44.62 ± 11.51 | 43.52 ± 11.83 | 0.788 |
| Triglycerides(mg/dl) | 172.40 ± 97.45 | 158.62± 82.30 | <0.005 |

## Mean HbA1c Changes between the First Visit and the Last Visit

Figure 1 shows that the mean HbA1c decreases significantly from the first visit to the last visit according to age $p<0.05$.

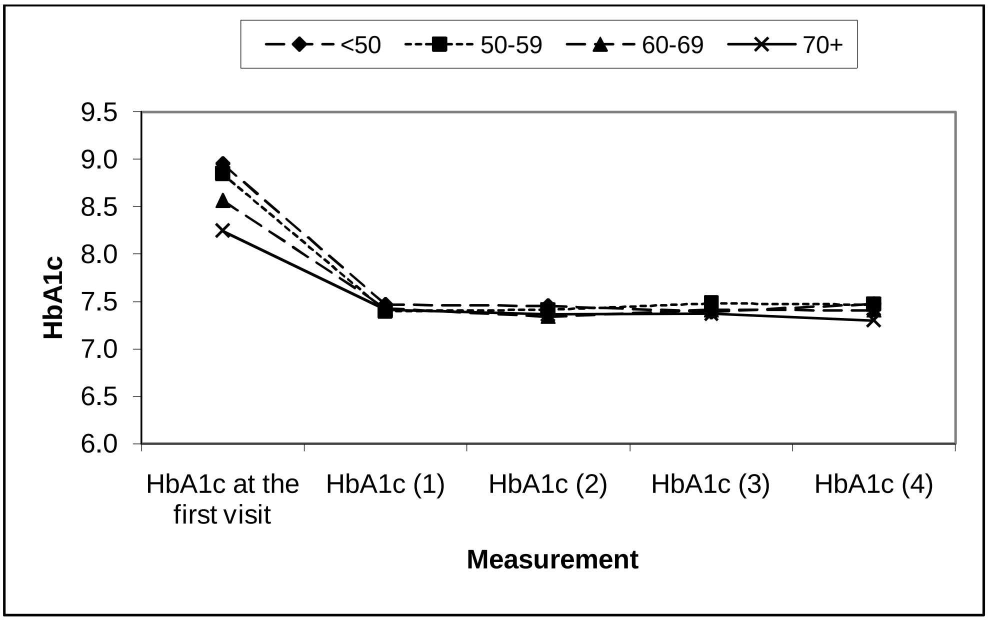



**Figure 1. Mean HbA1c changes with age**

**HbA1c (1): HbA1c measurement at last nine months**

**HbA1c (2): HbA1c measurement at last six months**

**HbA1c (3): HbA1c measurement at last three months**

**HbA1c (4): HbA1c measurement at last visit**

Figure 2 shows that the mean HbA1c decreases significantly from the first visit to the last visit according to the duration of diabetes.

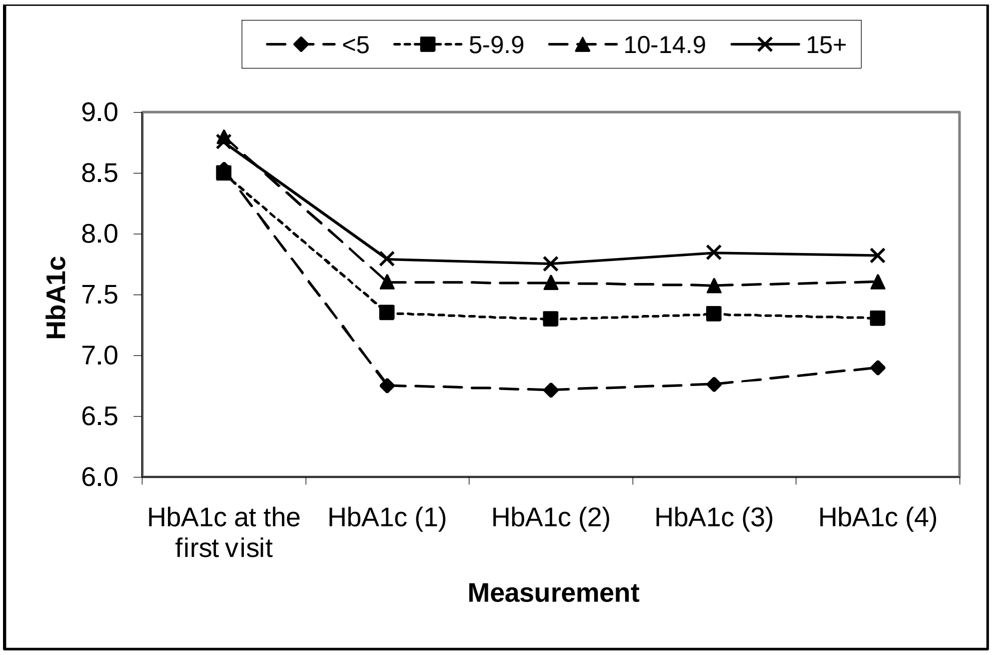



**Figure 2. Mean HbA1c changes with duration of diabetes**

**HbA1c (1): HbA1c measurement at last nine months**

**HbA1c (2): HbA1c measurement at last six months**

**HbA1c (3): HbA1c measurement at last three months**

**HbA1c (4): HbA1c measurement at last visit**

Figure 3 shows that the mean HbA1c decreases significantly from the first visit to the last visit according to BMI $p<0.05$.

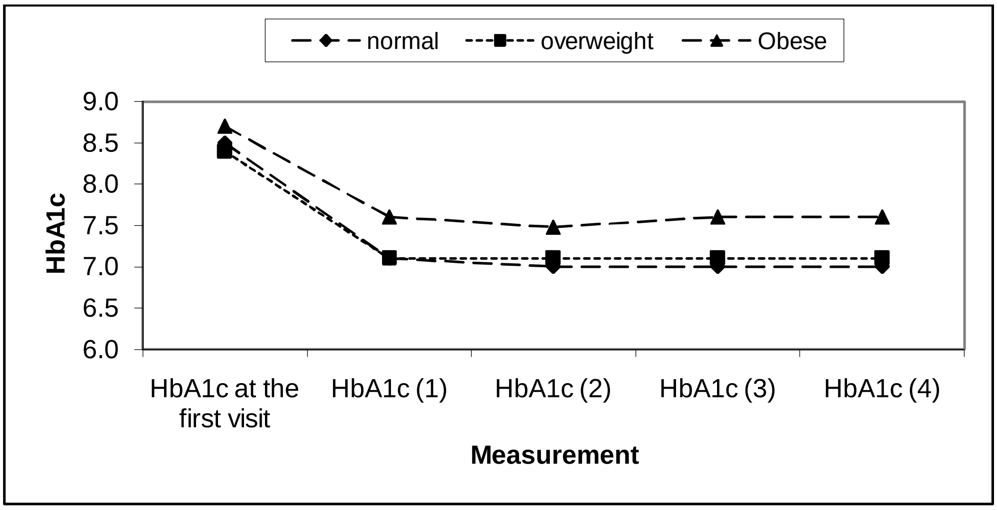



**Figure 3. Mean HbA1c changes with BMI**

**HbA1c (1): HbA1c measurement at last nine months**

**HbA1c (2): HbA1c measurement at last six months**

**HbA1c (3): HbA1c measurement at last three months**

**HbA1c (4): HbA1c measurement at last visit**

Figure 4 shows that the mean HbA1c decreases significantly from the first visit to the last visit according to medication $p<0.05$.

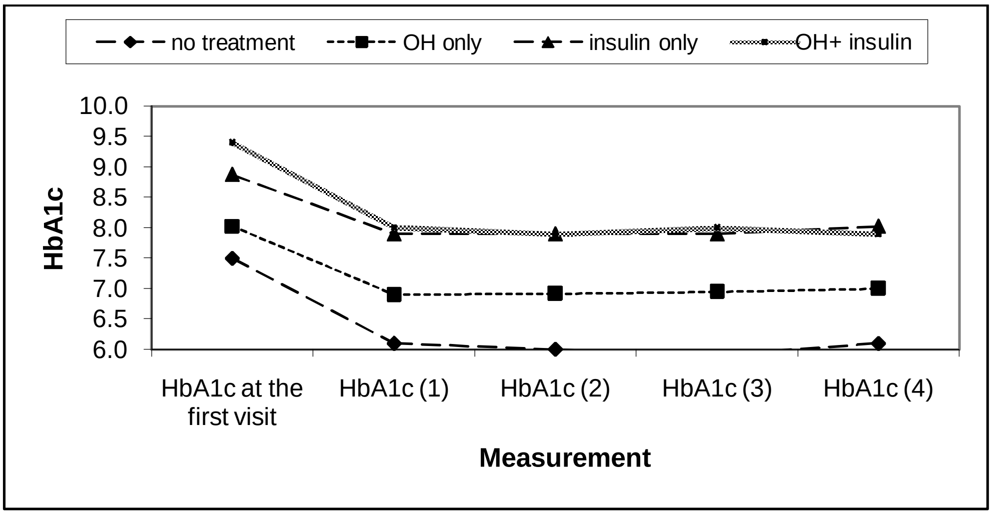



**Figure 4. Mean HbA1c changes with medication**

**HbA1c (1): HbA1c measurement at last nine months**

**HbA1c (2): HbA1c measurement at last six months**

**HbA1c (3): HbA1c measurement at last three months**

**HbA1c (4): HbA1c measurement at last visit**

## Changes of Mean Systolic Blood Pressure and Diastolic Blood Pressure from the First Visit to the Last Visit

Figures 5 shows the changes in mean systolic blood pressure from the first visit to the last visit among the study population, and it shows there was an increase in mean systolic blood pressure from the first visit to the last visit ($p<0.05$).

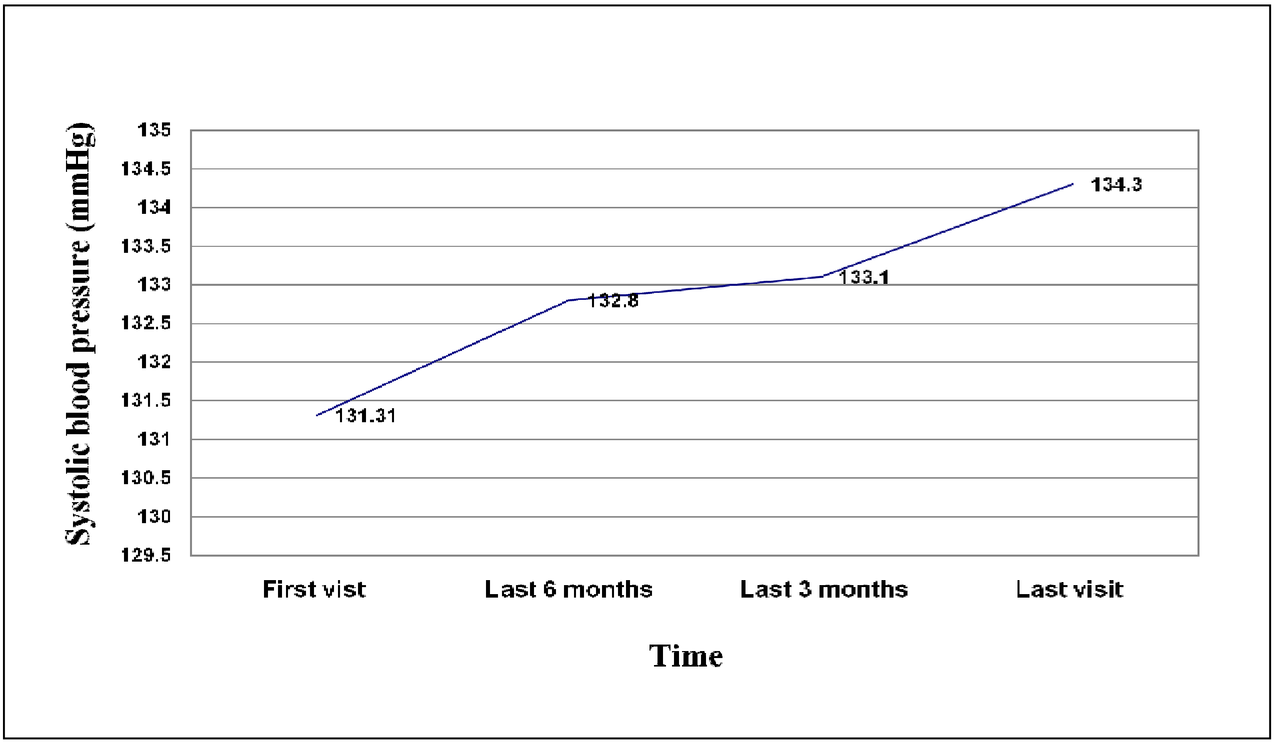



**Figure 5. Changes of mean systolic blood pressure from the first visit to the last visit among the study population**

Figures 6 shows the changes in mean diastolic blood pressure from the first visit to the last visit among the study population, and it shows there was a decrease in mean diastolic blood pressure from the first visit to the last visit ($p<0.05$).

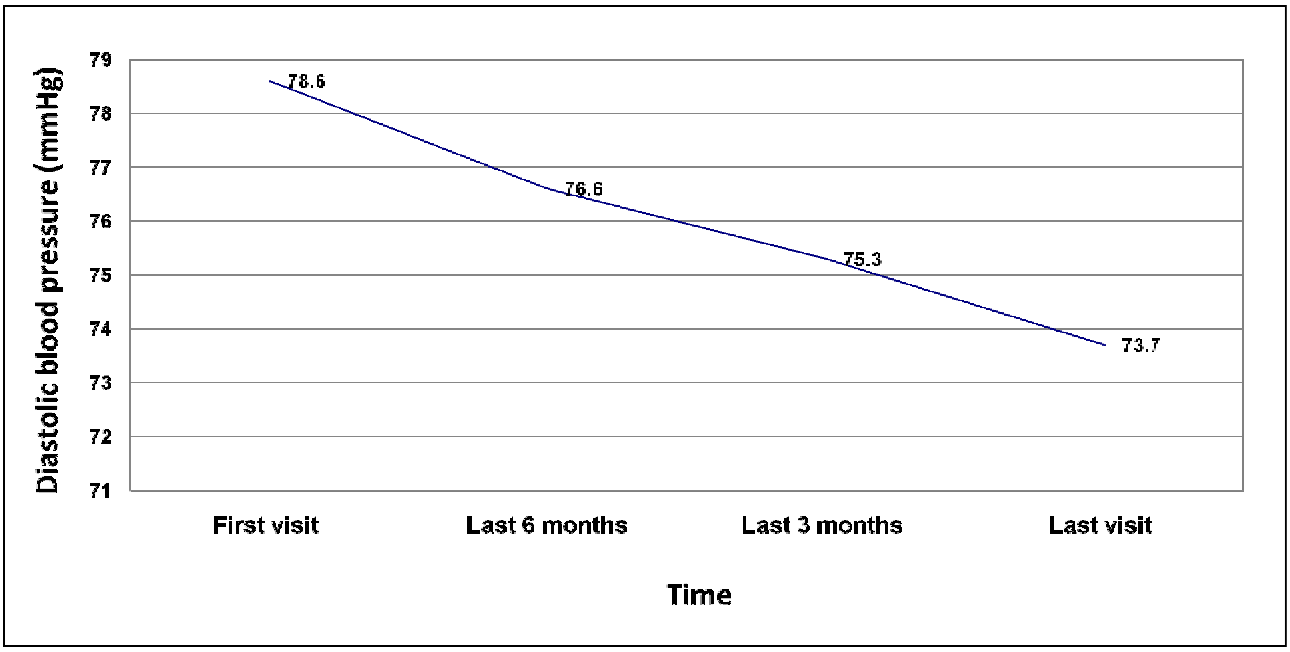



**Figure 6. Changes of mean diastolic BP from the first visit to the last visit among the study population**

Figures 7 shows the changes in mean systolic blood pressure from the first visit to the last visit among patients diagnosed to have hypertension in the first, and it shows there was no significant change in mean systolic blood pressure from the first visit to the last visit (from 136 mmHg to 136.5 mmHg).

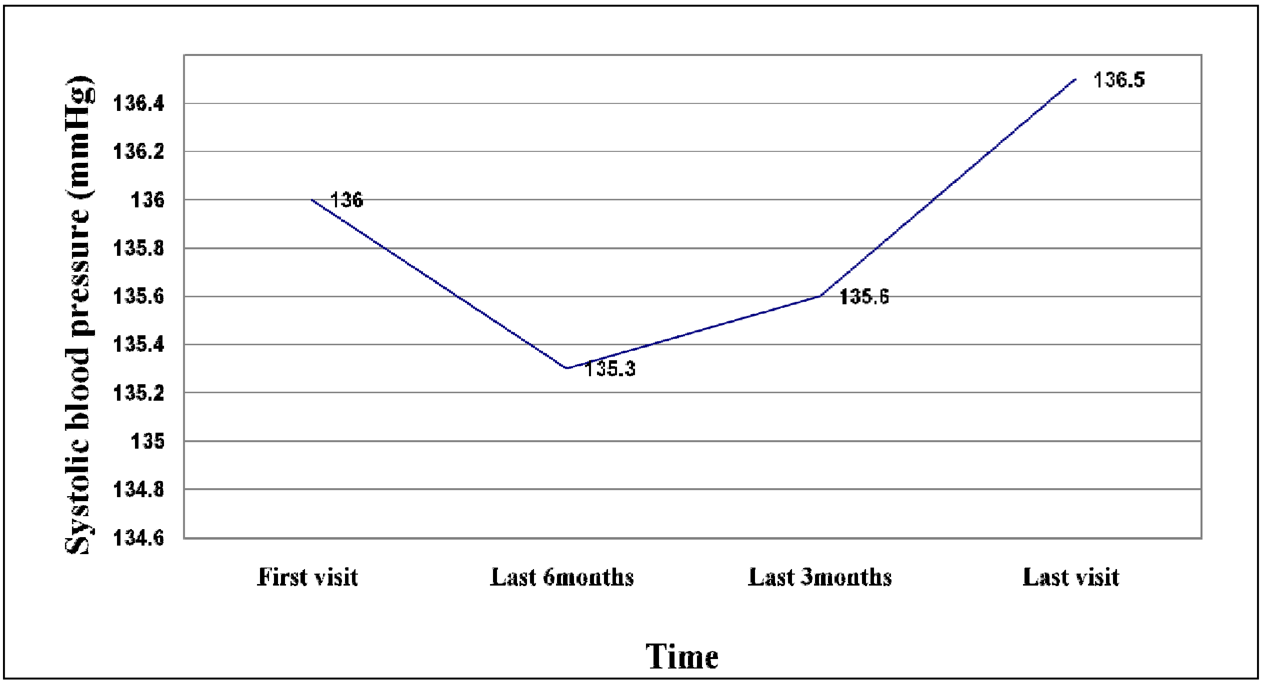



**Figure 7. Changes in mean systolic blood pressure from the first visit to the last visit among patients diagnosed to have hypertension in the first visit**

Figures 8 shows the changes in mean diastolic blood pressure from the first visit to the last visit among patients diagnosed to have hypertension in the first visit, and it shows there was a significant continous reduction in mean diastolic blood pressure from the first visit to the last visit.

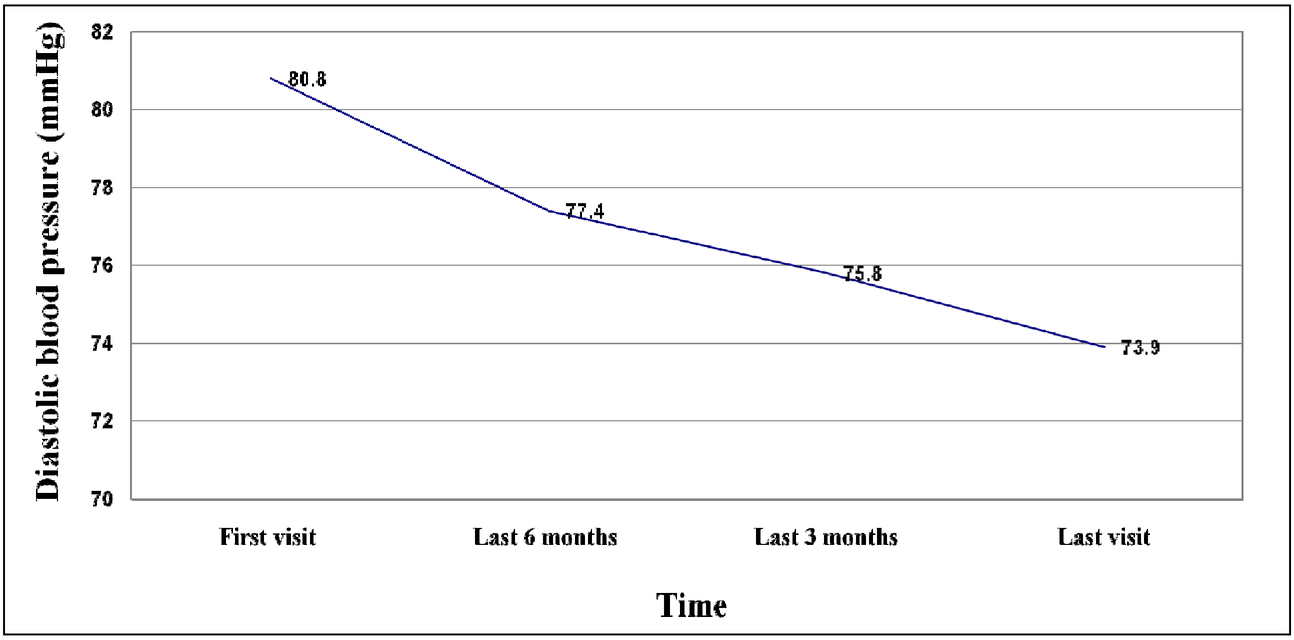



**Figure 8. Changes in mean diastolic blood pressure from the first visit to the last visit among patients diagnosed to have hypertension in the first visit**

Figures 9 shows the changes in mean systolic blood pressure from the first visit to last visit among patients who did not have hypertension in the first visit, and it shows there was a significant increase in mean systolic blood pressure from the first visit to the last visit.

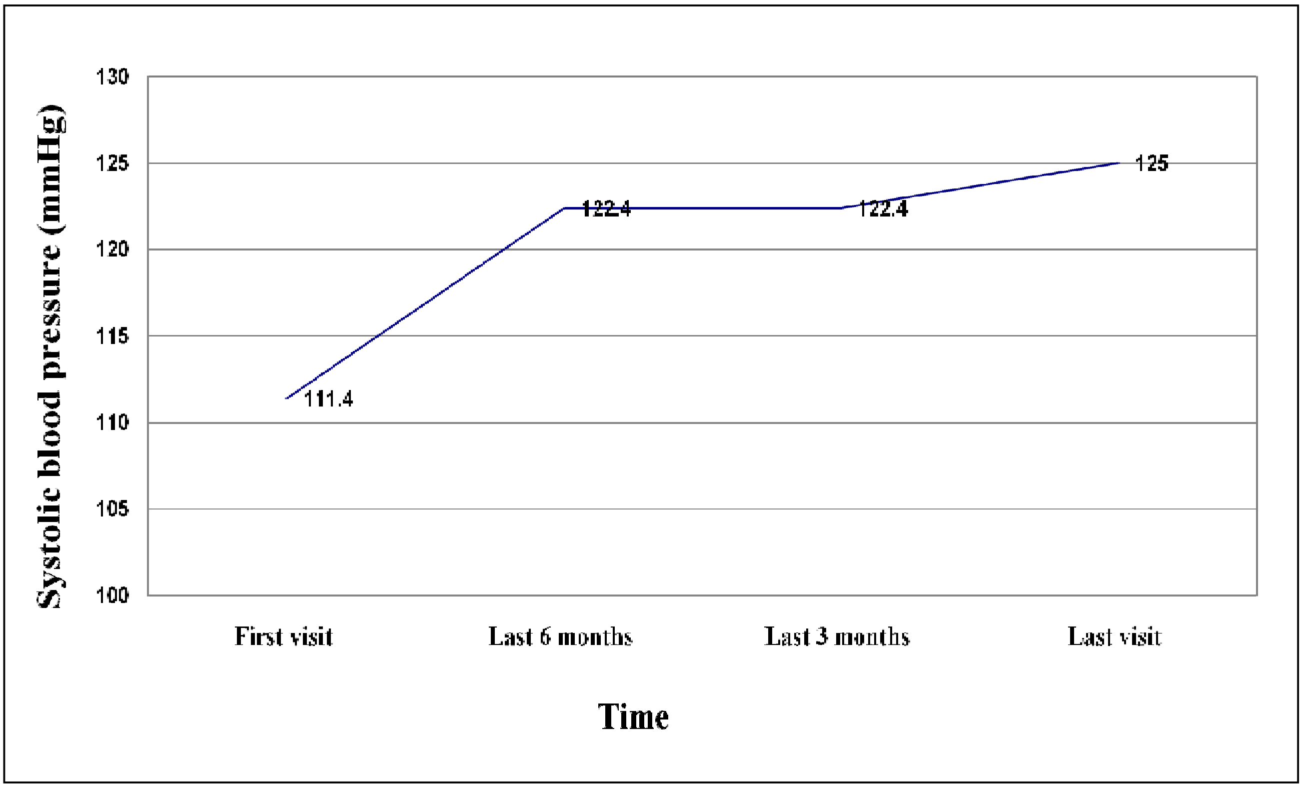



**Figure 9. Changes in mean diastolic blood pressure among patients who did not have hypertension in the first visit**

Figures 10 shows the changes in mean diastolic blood pressure from the first visit to the last visit among patients who did not have hypertension in the first visit, and it shows there was a significant increase in mean diastolic blood pressure from the first visit to the last visit.

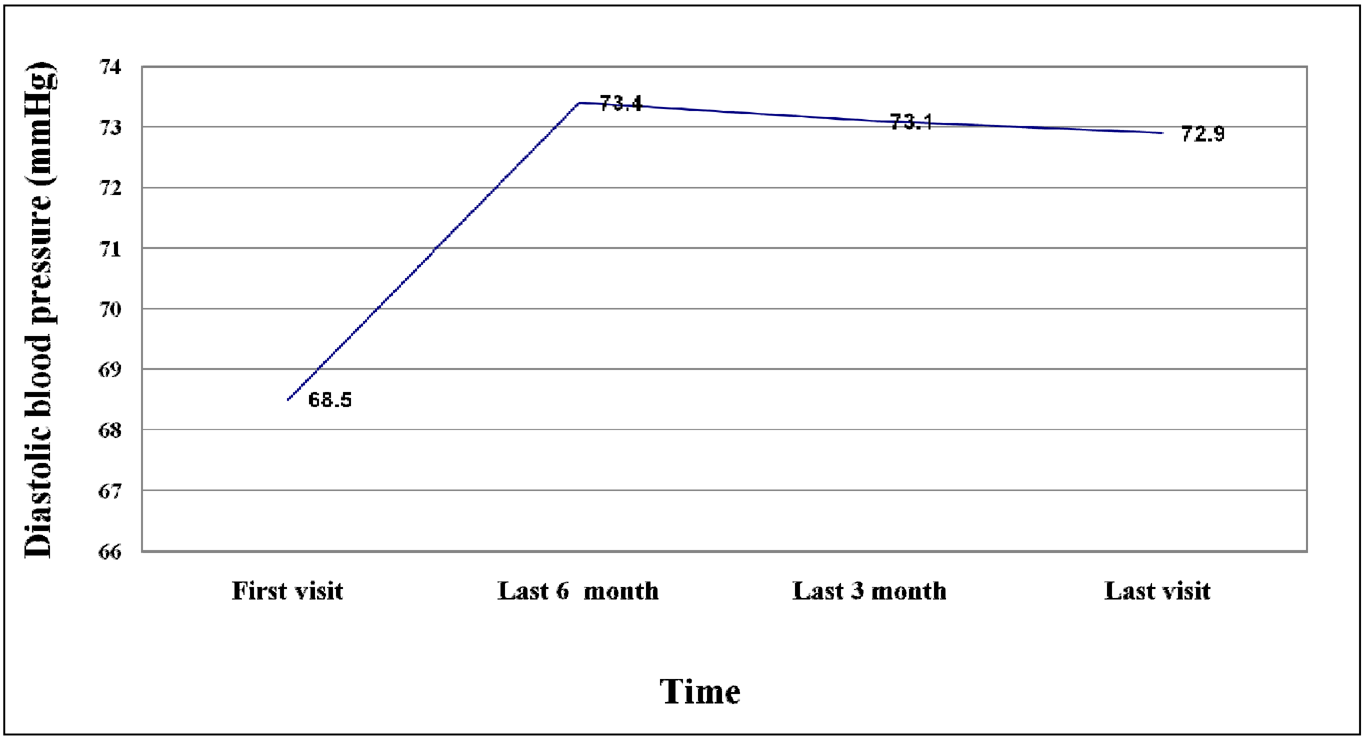



**Figure 10. Changes in mean diastolic blood pressure among patients who did not have hypertension in the first visit**

## Percentage of Diabetic Patients Reaching Recommended Treatment Goals

Figure 11 shows the percentage of diabetic patients reaching recommended treatment goals (HbA1c<7%, BP<130/80 mmHg, total cholesterol<200mg/dl, LDL cholesterol<100 mg/dl, HDL cholesterol>50 mg/dl for females and >40 mg/dl for males and triglycerides <150 mg/dl).)

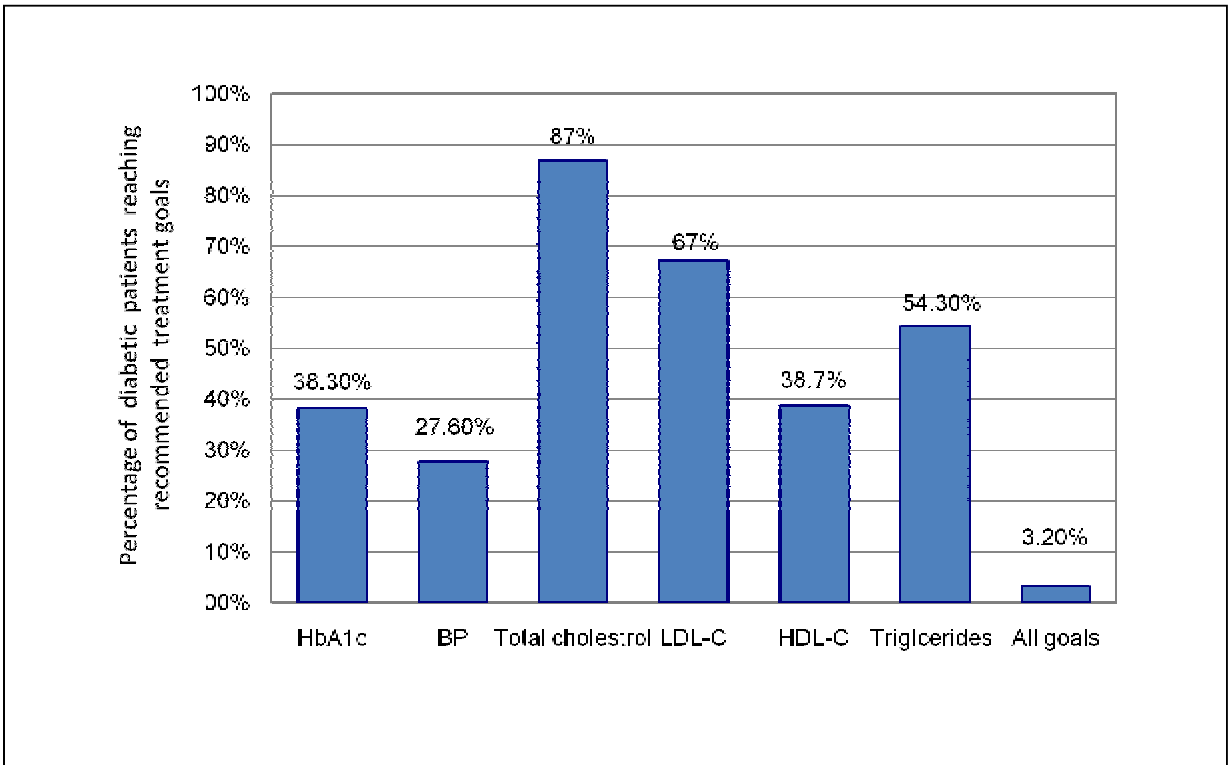



**Figure 11. Percentage of diabetic patients reaching recommended treatment goals**

The category of "All goals" means the percentage of diabetic patients reaching all recommended treatment goals in this study (HbA1c, BP, total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides together).

Figure 12 shows the percentage of diabetic patients reaching recommended treatment ABC goals.

The "ABCs of Diabetes" are defined as hemoglobin A1c < 7.0%, blood pressure < 130/80 mm Hg), and low density lipoprotein cholesterol (LDL-C) <100 mg /dL).[112]

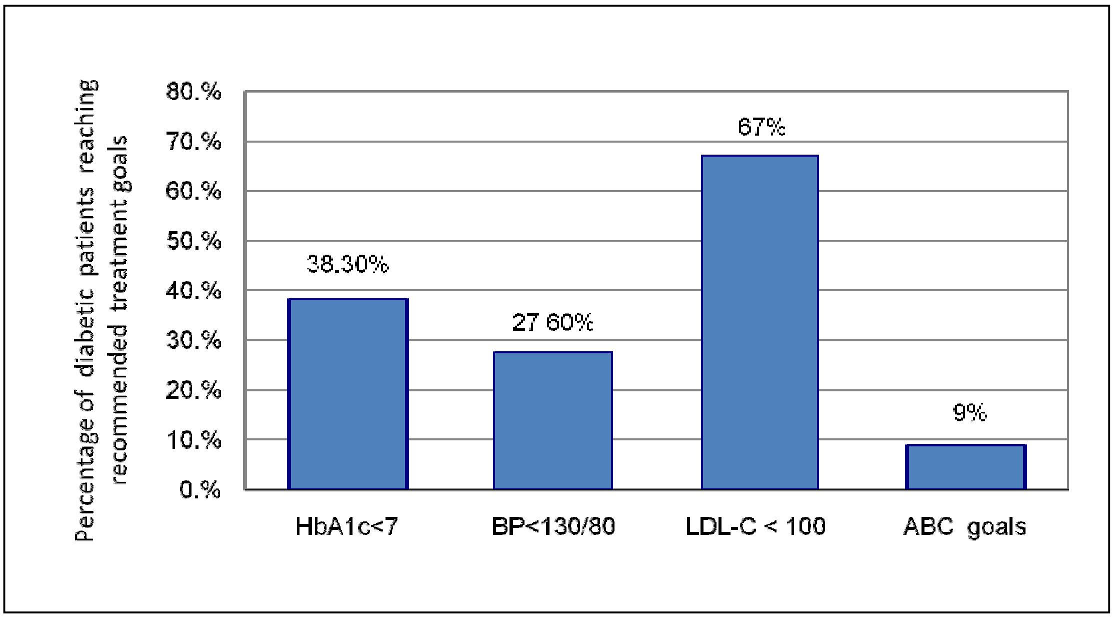



**Figure 12. The percentage of diabetic patients reaching recommended ABC goals**

**ABC means:**

**A =HbA1c**

**B = BP**

**C=LDL cholesterol**

# CHAPTER FIVE

# DISCUSSION

This study has estimated the proportion of patients with type 2 diabetes who achieved the target levels of HbA1c, blood pressure, total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides during treatment at the NCDEG.

In the present study, 38.3% of patients achieved the recommended target for HbA1c in the last visit after a mean follow up of 3.4 years. The proportion of patients with controlled HbA1c in the last two, three and four visits was 37.6%. 38.1% and 37.8%, respectively. There was statistically significant improvement in glycemic control between the first and the last visit (from 20.3% to 38.3%).

The level of glycemic control found in this study in the last visit is similar to the findings of other studies that were reported by Del Canizo-Gomez et al(73) and Beaton et al (80), in which a HbA1c<7% was achieved in 40% and 37% respectively .However, the level of glycemic control found in this study is lower than other studies reported by Mengual et al (74) , Colivicchi et al(75), Meisinger et al(78), Cortez-Diazet et al(79), Bergenstal et al(80) and Suzuki et al(82), in which a HbA1c <7 % was achieved in 50%, 57.8%, 46.6%, 51.7%, 67.6% and 46.8% respectively.

A higher prevalence of good glycemic control was not achieved in NCDEG possibly because around 90% of the study population were overweight and obese.

In Arab countries this level of control is better than that reported in Kuwait (86) and in another Country (83).

The result of glycemic control in this study is better than the previous study at NCDEG that was reported by Adham et al[87]in which 27.7% of the studied population achieved a HbA1c <7%. The explanation for this better control may be related to a longer duration of follow up.

This study showed that glycemic control was better in males than females, which is consistent with the data from a number of studies which have been reported by Cortez-Diazet al [79] and Kattab et al [89].The explanation of worse glycemic control in females may be due to the lack of exercise and physical activitiy.

Data showed worse glycemic control with longer duration of diabetes. These findings are consistent with data from a number of studies [113,35,114] and a previous study from this Center [87].The explanation of worse glycemic control by time could be explained by the progressive loss of the beta cell function and the increased fat cell mass that is associated with the increase in age [35].

In agreement with a number of studies, which have been reported by Valle et al[114] and Goudswarrd et al [115],the results of this study showed a significant correlation between worse glycemic control and higher body mass index .This is probably related to the association of insulin resistance with a higher body mass index.

With poor glycemic control, the prevalence of microvascular complications increased significantly in this study, and this finding is consistent with the UKPDS [35].

In UKPDS, it was found that there was no significant correlation between the glycemic control and macrovascular complications [35], but in our study there

was no significant correlation between glycemic control and stroke and diabetic foot ulcers only.

The prevalence of retinopathy among our study population was 32.9 %. This result is consistent with another study conducted at the same center by Al-Amer et al[116],in which the prevalence of retinopathy was 34.1%, and this result is higher than that reported by Abasit et al[117] in Pakistan, in which the prevalence of retinopathy was 15.9%.

The prevalence of microalbuminuria among our study population was 30.7%, and this result is higher than that reported by Orozco et al [72] and Meisnger et al, [78] in which the prevalence of microalbuminuria was 26.7 % and 27.2% respectively. In the Orozco-Beltran et al study[72] microalbuminuria was defined as a 24-hour microalbminuria between 30-300 mg/24 hours and in the Mesinger et al study[78] microalbuminuria was defined as an albumin –creatinine ratio of 30 to 300 mg/g.

The prevalence of symptomatic neuropathy among our study population was 55.4%, and this prevalence is less than the study reported by Abasit et al [117], in which the prevalence of neuropathy was 63.1%.

The prevalence of CHD among our study population was 16.8%,and this prevalence is consistent with another study reported by Abasit et al[117], in which the prevalence of CHD was 15.1% and was more than the study reported by Colivicchi et al[75],in which the prevalence of CHD was 12.6%.

In our study, the prevalence of CHD was more among males than females. This is consistent with other studies reported by Abasit et al[117]and Colivicchi et al[75]. This is probably related to the higher prevalence of smoking among

males [118] ,in addition male gender is one of non modifiable risk factors for CHD [119] .

The prevalence of stroke among our study population was 4.1%. This finding is consistent with another study reported by Abasit et al[117], in which the prevalence of stroke was 4.4% and was higher than the study conducted by Colivicchi et al[75], in which the prevalence of stroke was 2.6%.

The prevalence of diabetic foot ulcers among our study population was 5.2%, and this prevalence is less than the study reported by Abasit et al[117], in which the prevalence of diabetic foot ulcer was 10.4%.

The prevalence of diabetic foot ulcers was more among males than females and this is consistent with another study reported by Abasit et al [117]. This is probably related to the higher prevalence of smoking among males.[118]

This study showed the lack of association between age and glycemic control, and this finding is consistent with the previous finding in this center reported by Adham et al[87], but it is not consistent with the findings of other studies reported by Benoit et al[120]and Goudswarrd et al.[115]

The results of this study showed that the mean HbA1c in patients who took oral antidiabetic agents alone was better than patients who took insulin alone or a combination of both, which is similar to the findings reported in other studies [114,115].This may be related to the fact that patients receiving insulin are usually those who are having worse glycemic control with progressive loss of B cell function [89].

The prevalence of hypertension (BP > 130/80 mmHg or on medication for high blood pressure) in t he study population increased after mean follow up of 3.4 years from 80.7% to 92.8%. This prevalence of hypertension is higher than the previous study that was conducted by Mubarak et al [88] in which the prevalence was 72.4%. This could be explained by the fact that 56% of our study population were > 50 years of age.

In this study, 27.6% of diabetic patients have controlled hypertension (BP < 130/80 mmHg). This finding is better than those reported by Orozco-Beltran et al [72] and Cortez-Dias et al [78] in which a BP < 130/80mmHg was found in 7.8% and 9.3% respectively, but is consistent with the finding of the Colivicchi et al study [75], in which BP<130/80 mmHg was achieved in 29.6% of the study population.

In our study there was an association between uncontrolled hypertension and uncontrolled diabetes, and this finding is consistent with Orozco et al study [72].

There was no statistically significant improvement in systolic blood pressure between the first and last visit among the study population.

The study shows that the prevalence of uncontrolled systolic blood pressure level was 65.3 %, while 37.1% of patients had diastolic BP > 80mmHg. This may be due to the fact that isolated systolic hypertension is the predominant type of hypertension in older people [121].

The prevalence of dyslipidemia among our study population diagnosed at the first visit (based on either abnormal lipid profile or maintained on lipid lowering agents) was 92.4%. This prevalence increased to 96.3% after a mean follow up of 3.4 years and is higher than that reported previously in the NCDEG center

by Abdel-Aal et al[90],using similar cut off points for abnormal lipid parameters.

The recommended goals for controlled total cholesterol <200mg/dl, controlled HDL cholesterol >50 mg/dl for females and >40 mg/dl for males, controlled LDL cholesterol <100 mg/dl and controlled triglycerides <150 mg/dl were achieved in 87%, 38.7%, 61.3% and 45.7% respectively in our study. LDL cholesterol control in this study is higher than other studies reported by Orozco-Beltran et al[72],Gomes et al[73] and Colivicchi et al[75] in which the LDL cholesterol level of <100 mg/dl was achieved in 5.9%,41% and 25.5% respectively. The control of total cholesterol is consistent with the study reported by AL-Sultan et al[86] in Kuwait, in which total cholesterol of <200 mg/dl was achieved in 48% and the control of triglycerides is consistent with the study reported by Del Canizo-Gomez et a.[73].

In our study the uncontrolled diabetic subjects were more likely to have uncontrolled LDL cholesterol and elevated total cholesterol, and this result is consistent with other studies reported by Orozco-Beltran et al.[73],Benoit et al[119], and Goudswarrd et al[115].

The findings of this study indicated that males were more likely to have controlled TC, LDL-C and HDL-C than females, and this finding is consistent with the previous study at the NCDEG [90].

The data showed there was significant improvement in the total cholesterol, LDL cholesterol and triglycerides among patients with type 2 diabetes between the first and the last visit but this was not observed for the HDL cholesterol level, and this may be related to a longer duration of diabetes.

The study shows that the percentage of diabetic patients who reached all ABC goals together (HbA1c less than 7%, blood pressure less than 130/80 mmHg, and LDL cholesterol less than 100 mg/dl) reached 9.0% compared with 4.1% reported by Yu et al [122], 7.3% reported in the U.S NHANES 1999-2000 survey[77] and 22% reported from a community–based endocrinology practice in the U.S [123]. However, the last 2 surveys used only total cholesterol of less than 200mg/dl as a standard.

Data showed that 3.1% of diabetic patients reached the goals of HbA1c less than 7%, blood pressure less than 130/80 mmHg, LDL cholesterol less than 100 mg/dl, total cholesterol less than 200 mg/dl, triglycerides less than 150 and HDL cholesterol more than 50 mg/dl for females and more than 40 mg/dl for males . The lack of adherence to medical therapy may be one of the reasons for not achieving all the treatment goals together.

**Limitations of the Study**

It is a retrospective study. The data have been obtained from reviewing medical files in which there was a lack of documentation especially from dietitians and health educators. Because of these reasons, the researcher usually faces incomplete information.

**Strengths of Study**

The number of the study population was relatively large. At the NCDEG the patients either come from all over the country directly or are refereed from other clinics in Jordan. According to my knowledge, there has been no study done in

Jordan that has reported the changes in HbA1c, blood pressure, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides after follow up

**Conclusions and Recommendations**

Based on the results of this study, it was found that the prevalence of target glycemic control among the study population was 38.3%, the prevalence of target blood pressure among the study population was 27.3% ,the prevalence of target total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides was 87.7%, 67.1%, 38.7%, and 54.3%, respectively , and only 3.2% of diabetic patients reached recommended treatment goals combined (HbA1c < 7%, BP <130/80 mmHg, total cholesterol <200 mg/dl, LDL cholesterol <100 mg/dl, HDL cholesterol >50 mg/dl for females and > 40 mg/dl for males and triglycerides <150 mg/dl).

There was significant improvement in HbA1c level, total cholesterol, LDL cholesterol and triglycerides after follow up.

Factors associated with poor glycemic control were higher BMI, increased waist circumference and longer duration of diabetes.

The results of our study provide further evidence for the need to implement aggressive glycemic, BP, and lipid management to improve goal achievement and reduction of cardiovascular disease among diabetic patients ..

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# APPENDICES

# Appendix (A)

**Sociodemographic data:**

File No: National number: phone:

1. Age in years:
2. Sex: 1-male 2-female
3. Occupation: 1- employed 2- unemployed 3- retired
4. Insurance: 1- Ministry of health 2- Not insured 3- Others
5. Level of education: 1- Illiterate 2- school 3- University

- **Medical history at first visit:**
    1. Date of first visit (dd/mm/yy):
    2. Duration of diabetes diagnosis at presentation(years):
    3. Age in years at diagnosis
    4. Smoking: 1- Smoker 2-Past smoker 3- Non- smoker 4-Unknown
    5. Anthropometric measurement at first visit: Height(cm): Weight(kg): Waist circumference (cm):
    6. BP (mmHg) at first visit : systolic BP (mmHg) : diastolic BP (mmHg) :

| 6.Diseases: | Yes | No | Unknown |
|---|---|---|---|
| Hypertension(HTN) | | | |
| Coronary heart disease(CHD) | | | |
| Stroke | | | |
| Dyslipidemia | | | |
| Retinopathy | | | |
| Neuropathy | | | |
| Chronic kidney disease (CKD) | | | |
| Diabetic Foot Ulcer | | | |

| **16. Treatment at first visit** | **yes** | **no** |
|---|---|---|
| Diet/exercise | | |
| Metformin | | |
| sulfonylurea | | |
| Non sulfonylurea | | |
| Thiazolidinediones (TZDs) | | |
| Dipeptidyl peptidase-4 inhibitor (DPP-4 inhibitor) | | |
| Insulin(full regemin) | | |
| Insulin two doses | | |
| Insulin (basal)one dose | | |
| Insulin (basal)two doses | | |
| Angiotensin-converting enzyme inhibitors(ACE inhibitors) | | |
| Angiotensin Receptor blocker(ARBs) | | |
| Calcium channel blocker(dihydropyridine) | | |
| Calcium channel blocker(non dihydropyridne) | | |
| Beta blocker | | |
| Alph and Betabloker | | |
| Thiazide Diuretics | | |
| Loop Diuretics | | |
| Aldactone | | |
| Centrally acting anti HTN agents | | |
| Alpha blocker | | |
| Brinerdine | | |
| Aspirin | | |
| Clopidogrel | | |
| Statin | | |
| Fibrate | | |
| Omega 3 | | |
| Ezitemibe | | |
| Nicotinomide | | |
| Bile Acid Sequestrants | | |

**Medical history at last visit**

1. Date of last visit (dd/mm/yy):
2. Duration of follow up in NCDEG :
3. Number of visits to NCDEG :
4. Anthropometric measurement at last visit:
   Height (cm): Weight (kg):

   Waist circumference (cm):

5. BP(mmHg) at last visit : systolic BP(mmHg):
   diastolic BP(mmHg) :

| 6.Diseases: | Yes | No | Unknown |
|---|---|---|---|
| Hypertension(HTN) | | | |
| Coronary heart disease (CHD) | | | |
| Stroke | | | |
| Dyslipidemia | | | |
| Retinopathy | | | |
| Neuropathy | | | |
| Chronic kidney disease (CKD) | | | |
| Diabetic foot ulcer | | | |

| **16. Treatment at last visit** | **yes** | **no** |
|---|---|---|
| Diet/exercise | | |
| Metformin | | |
| Sulfonylurea | | |
| Non sulfonylurea | | |
| Thiazolidinediones (TZDs) | | |
| Dipeptidyl peptidase-4 inhibitor (DPP-4 inhibitor) | | |
| Insulin(full regemin) | | |
| Insulin two doses | | |
| Insulin (basal)one dose | | |
| Insulin (basal)two doses | | |
| Angiotensin-converting enzyme inhibitors(ACE inhibitors) | | |
| Angiotensin Receptor blocker(ARBs) | | |
| Calcium channel blocker (dihydropyridine) | | |
| Calcium channel blocker (non dihydropyridne) | | |
| Beta blocker | | |
| Alph and Beta blocker | | |
| Thiazide Diuretics | | |
| Loop Diuretics | | |
| Aldactone | | |
| Centrally acting anti HTN agents | | |
| Alph blocker | | |
| Brinerdine | | |
| Aspirin | | |
| Clopidogrel | | |
| Statin | | |
| Fibrate | | |
| Omega 3 | | |
| Ezitemibe | | |
| Nicotinomide | | |
| Bile Acid Sequestrants | | |

**Clinical Laboratory Data:**

**Last 4 HbA1c Results**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Date | | | | |
| HbA1c | | | | |

| **Test** | **At first visit** | **Date of first visit** | **At last visit** | **Date of current visit** |
|---|---|---|---|---|
| HbA1c | | | | |
| Total Cholesterol | | | | |
| HDL Cholesterol | | | | |
| LDL Cholesterol | | | | |
| Triglycerides | | | | |
| Serum creatinine. | | | | |
| Microalbumin by dipstick | | | | |

**مدى تحقيق السيطرة على السكري والعوامل المرتبطه في مرضى السكري من النوع الثاني في المركز الوطني للسكري والغدد الصم والوراثة في عمان ، الأردن**

إعداد
**الدكتوره خديجه باشيخ**

المشرف
**البرفسور كامل العجلوني**

المساعد المشرف
**الدكتوره نهله الخواجا**

المشرف الإحصائي
**الدكتور يوسف خضر القاعود**

الملخص

**اهداف الدراسه:** تهدف الدراسه الى تحديد مستوى ضبط السكري في الدم ومستوى ضبط التوتر الشرياني ومستوى ضبط اعتلال الدهنيات لمرضى السكري النوع الثاني الذين يراجعون المركز الوطني للسكري والغدد الصم والوراثة في عمان ، الأردن ودراسه التغير في نسبة ضبط السكر في الدم (نسبة الهيوغلوبين المتعسلن ) و ضبط التوتر الشرياني و ضبط اعتلال الدهنيات أثناء العلاج في المركز الوطني للسكري والغدد الصم والوراثة ما بين الزيارة الاولى والزيارة الاخيره .

**الأساليب:** تم تحليل البيانات من خلال دراسة استعادية (ارتجاعيه) التي شملت عينة عشوائية منتظمة من 1576 مريض الذين راجعو مركز السكري خلال الفتره٢٠١٠/١٢/١ الى٢٠١١/٣/٣١ الذين لهم اكثر من اربع زيارت في السنه الاخيره

**النتائج :** اثبت الدراسه ان معدل انتشار مستوى اعتلال الدهنيات عند المرضى المصابين بالنوع الثاني كان 96.3%، و معدل انتشار ارتفاع التوتر الشرياني كان 92.8% و معدل تحقيق السيطرة الجيده على سكر الدم (مستوى نسبة الهيوغلوبين المتعسلن <٧ ٪) من بين الذين شملتهم الدراسة كان ٣٨.٣ ٪ في الزيارة الأخيرة مقارنة مع ٢٠.٣ ٪ في الزيارة الأولى وقد كان معدل تحقيق السيطرة الجيدة على التوتر الشرياني (<١٣٠/٨٠ ملميتر زئبقي) من بين الذين شملتهم الدراسة ٢٧.٣ ٪ في الزيارة الأخيرة. وكان معدل تحقيق السيطرة الجيدة على الكولسترول الكلي (< ٢٠٠ ملغرام/ ديسلتر) ، والكولسترول الضار (< ١٠٠ملغرام/ ديسلتر) ، والكولسترول الحميد (> ٥٠ ملغرام/ ديسلتر للنساء و> ٤٠ ملغرام/ ديسلتر للرجال) والدهون الثلاثية (< ١٥٠ملغرام/ ديسلتر) 87.7 ٪ ، 67.1 ٪ ، و ٣٨.٧ ٪ ، و ٥٤.٣ ٪ على التوالي في الزيارةالأخيرة.

**الخلاصة :** إن معدل تحقيق الهدف في السيطرة الجيدة على سكر الدم , والتوتر الشرياني ، والكولسترول الكلي ، الكولسترول الضار والكولسترول الحميد والدهون الثلاثية مطابق لدراسات اخرى في دول عدة.وقد أثبت الدراسة تحسن ملحوظ في مستوى نسبة الهيوغلوبين المتعسلن ، والكولسترول الكلي ، الكولسترول الضار والدهون الثلاثية بعد المتابعة في المركز. كما اثبت الدراسه ان العوامل المرتبطة في السيطرة على سكر الدم هي انخفاض مؤشر كتلة الجسم ومحيط الخصر وقصر مدة الاصابة بالسكري.

**الكلمات الرئيسية :** مرض السكري ،عوامل الخطر القلبية الوعائية ،ارتفاع ضغط الدم، اعتلال الدهنيات، الأردن، المركز الوطني للسكري والغدد الصم والوراثة في عمان .